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FREEDOM AND LOYALTY

IN the course of his inspiring address on "The Scientist in Industry" to the Federation of British Industries at a meeting held at the Royal Institution on March 19 in honour of him and Sir Robert Robinson as Nobel Prize winners in 1947, Sir Edward Appleton referred to the vital importance of avoiding any segregation or isolation of research effort. He spoke also of the need for interpreting as liberally as possible whatever restrictions may have to be imposed in the interests of Government departments or industrial firms on men of science serving such organisations. Sir Edward's address was pervaded with a lively sense of the value of human factors; and above all of the importance of freedom of intercourse and movement; his words, indeed, contrast strongly with the restrictions which the Government announced a few days earlier on the employment of members of Communist and Fascist organisations in the service of the State. On grounds of national security, the Government has concluded that the only prudent course to adopt is to ensure that no one who is known to be a member of the Communist Party, or to be associated with it in such a way as to raise legitimate doubts about his or her reliability, is employed in connexion with work the nature of which is vital to the security of the State.

No reasonable exception can be taken to the terms of the Prime Minister's statement. The State, he said, is not concerned with the political views as such of its servants, and so far as possible alternative employment on the wide range of non-secret Government work will be found for those who are deemed to be unsuitable for secret work. Experience both in Great Britain and elsewhere has shown that membership of, and other forms of continuing association with, the Communist Party, may involve the acceptance by the individual of a loyalty which in certain circumstances can be inimical to the State.

However regrettable this decision may be—and there are consequences that involve some further consideration—no Government could pretend that there are not certain duties of such secrecy that the State ought not to employ in connexion with them anyone whose political discretion is in doubt. It shows a misconception of the Prime Minister's statement and purpose to urge that such action should only be taken after the individual concerned had had opportunity of appeal to some form of tribunal, or after weighing evidence by a judicial process. The point is that there is no specific charge brought against the individuals affected. As Mr. Attlee said, it is not suggested that in matters affecting the security of the State all Civil servants who adhere to the Communist Party would allow themselves to forget their primary loyalty to the State; but there is no way of distinguishing such people from those who might endanger the security of the State.

The Government in this precautionary measure has manifestly stopped well short of the point at which liberty and conscience are imperilled or economic sanctions raised against particular political creeds. Western democracy works by toleration and

governs by consent, and the Government's moderation is in startling contrast to the methods pursued by Eastern communism—its rigid intolerance, intransigence and persistent attempts to over-run the frontiers of sincere democratic patriotism, and to crush freedom wherever it exists. To survey the plight of freedom in the satellite countries of the U.S.S.R. is to realize the enormous contrast, and also the moderation and realism of the British Government's action.

The University of Prague, which has been celebrating its sixth centenary, provides a case in point. In view of their information that for the time being the Charles IV University is subject to Government controls which deny to it the academic autonomy essential to all free and responsible university work, the universities of Great Britain reluctantly decided that their official representation at the celebrations would be inappropriate. Every university felt itself honoured by the invitation to Prague, and desired to pay tribute to the high and historic service of the Charles IV University to scholarship and science, and to the making of our common heritage of truth and freedom; but Sir Hector Hetherington, acting chairman of the Committee of Vice-Chancellors, has stated in *The Times* that it has seemed necessary to the universities to give no ground for the opinion that British universities are favourable to the changes wrought in the universities of Czechoslovakia.

That action, moreover, illustrates further a point made in a recent article in *The Economist*. There is urgent need, it was argued, for an effective counter-attack on communist activities and propaganda in all walks of life, in public affairs, in science particularly, and above all in the factories. Recent events have made a little plainer whither divided loyalties may lead us; but if the free nations are to preserve their liberties and their great traditions, they cannot continue to tolerate intolerance. They must, it is true, work out their own means of self-protection by their own democratic method; but they must not allow themselves to be deceived by the professions of those who reject these methods and only use them to subserve their purpose of intolerance and disruption.

In contrasting Sir Edward Appleton's words with the new policy, it should have been noted that in his plea for freedom he stressed the discipline of science. That should be the first loyalty of the man of science; and it is because that discipline and loyalty are rejected by the communist that science itself is endangered by communism as we know it in Soviet Russia. The totalitarian regime is inconsistent with the free pursuit of science, and professional workers would do well to address themselves more carefully to this question of professional loyalty. Without loyalty to the highest professional ideals and traditions, inherent in which is the tradition of faithful service to the society for whose welfare a profession exists, the pursuit of truth and the advancement of learning cannot long endure.

In this connexion Mr. Middleton Murry has a significant passage in his recent book "The Free Society"*. He is convinced that the contemporary confidence in the autonomy and invulnerability of science has no solid foundation. Science, he holds, is as vulnerable as the free society and is ultimately dependent on it. "The matrix of science has been the politically free society, first in Greece, then in the final form of the Christian society. It was only when the Christian impulse, with the aid of the Roman tradition of law, had created for the intellectual freedom of Greek speculation a body politic which assured it of an abiding home that science, in the modern sense, became possible. For science lives by a continuous tradition of scientific integrity, created and continually renewed by conscience. The scientific community is the child of the free society."

If Mr. Murry had done no more than direct attention to the new threat to scientific integrity which the spread of Russian communism offers, his book would have deserved attention. Men of science who were alert to the threat which the rise of Nazism and Fascism a decade and a half ago offered to science have sometimes been unhappily blind to the new danger. As Mr. Murry observes, members of the scientific community in the free society are frequently engaged in undermining that free society in the name of science, and there could not well be more alarming evidence of our peril. If the pursuit of research and of learning depends upon a consensus and community of consciences which are obtainable only within the free society, men of science must act in defence of that society.

That defence must be based upon understanding, and it is as a contribution to the clear thinking here required—which is the more imperative if the discrimination referred to in the Prime Minister's statement of March 15 is to be used wisely and without detriment to the democratic tradition or the growth of the free society—that Mr. Murry's book is most welcome. He is indeed challenging and provocative; and it would be a misfortune if the slightly dramatic character of the book diverted attention from the more fundamental issues which are raised.

What distinguishes the free society from other forms of society, according to Mr. Murry, is the prevalence within it of the fundamental liberties of the subject of freedom of conscience, of speech, of expression and of association. Those liberties are indeed subject to restraints, and he insists that it is by the achievement of tolerance that the free society becomes possible. Nevertheless, he argues cogently that in a world such as exists to-day, a free society can only be established by a government which, believing in the free society, is convinced of the necessity of refusing to tolerate the intolerant, and possesses the power to repress them with even-handed justice, both on the Right and on the Left.

Mr. Murry thus advances powerful reasons in support of the Government's decision; but in displaying the tension between the need for the satisfaction of conscience and the need for ordered society which the free society seeks to release, he brings to the front the immense moral issues involved. A free society,

* The Free Society. By John Middleton Murry. Pp. 292. (London: Andrew Dakers, Ltd., 1948.) 12s. 6d. net.

he says, lives by a firm belief that its citizens have the moral energy to correct their own mistakes, and to correct them before serious or irreparable harm is done to the fabric of the free society. It is a question of responsible power, conferred by the democratic process and exercised responsibly with respect to the rights of the minority and also to the welfare of the whole society. The free society, in fact, is a great experiment, and it is above all for his clear indication of the collective and moral responsibility of individuals and groups in Great Britain involved in this affirmation of the dignity, the freedom and responsibility of man that this book deserves to be pondered.

There is first, as Mr. Murry justly observes, room for doubt as to whether the workers appreciate the necessity of dealing justly with one another or with society as a whole. Here his words should be weighed by the trade unions as well as by professional associations in general. Before the free society can be regarded as reasonably secure, the workers must be taught their new responsibilities.

That may well be the most important and urgent task a free society has to undertake; but with it, and of it, must go an increasing consciousness of the whole in existing groups and associations. An ordered society requires discipline; but in a free society that social discipline must be a self-discipline; and here, as Mr. Murry reminds us, is the importance of voluntary groups and associations within the free society. To the degree to which they are inspired by an understanding of the free society, they will establish the patterns of just legislation before the need of legislation becomes acute. They will anticipate the social disciplines which the free society needs.

Now while Mr. Murry pertinently reminds us that in the free society the loyalty demanded is no longer primarily loyalty to the fellow-members of a group or section but to the free society as a whole, it is as well to remember that there is a converse side. The disciplines voluntarily accepted in the free society are disciplines which must be accepted above, by the government, as well as the governed; and they too must be inspired by an understanding of the free society as well as by a vision of its potentialities. To take only one instance at present in the public mind. It would be a grave mistake for the Government to imagine that the uneasiness of a large part of the medical profession over the new Health Act is not due to misgivings as to whether the profession will be able under the Act to give the public service which its professional ideals and traditions require it to render.

In dealing with the danger to the State of communist activities, a profound saying of Burke may be recalled: "It is no inconsiderable part of statesmanship to know how much of an evil ought to be tolerated". The Government has rightly decided that democratic principles do not call for the toleration of treason and terror, and it has wisely left it to the community to decide on the larger and fundamental issue, whether, in a democratic society, free scope should be given to those who seek to destroy democracy and to set up an intolerant regime.

If, therefore, the Government, in administering the decision, makes sure that impartial justice is done where the person concerned is not a member of the Communist Party but charged with "continuing association with it", it may well be claimed to have met Burke's test of statesmanship. That will not indeed avert the need for constant vigilance within and without Parliament. The debate on March 25 should have reassured those who fear that the cloak of security may be used to stifle the integrity of science and the ability of the scientific worker to serve mankind. But it is for scientific workers individually and in their professional associations to take up the challenge to fundamental thinking and constructive action which Mr. Murry throws down to them in "The Free Society"; in that way only can freedom be ultimately safeguarded in science or among the free nations of the world.

FAMILY AND NATION

THE broadsheet series entitled *Planning* issued from time to time by P.E.P. (Political and Economic Planning) has produced many excellent and stimulating documents, and has made a valuable contribution to the solution of several of the social and economic problems with which Britain has been and still is confronted. The latest issue, entitled "Family and Nation", is, however, frankly disappointing. Much of the information in it is of great interest, and it raises many important issues which need to be raised and to be raised frequently. Admittedly the family is difficult to plan for, being so variable and so individual; and there is unconscious or perhaps conscious humour in the statement that it "must be strengthened in the functions for which it is peculiarly suited, such as the production of children". After an excellent section reviewing the fluctuation in the birth-rate, the introduction of family allowances, and the present state of income-tax rebates, the broadsheet goes on to outline a plan whereby the 'para-medical' services, together with marriage guidance, can all be combined in a family welfare service.

Such a proposal needs the most careful consideration at the present time, for it presupposes a large expenditure of public money and it also cuts across the recommendations of the Denning Committee[1]. Both are serious matters, and one would therefore expect weighty reasons to be given in support of the proposal.

The functions of the proposed new organisation would be to "improve the conditions in which children grow up, increase the number of 'wanted' children and help to reduce the number of children whose birth is not desired either by their parents or by the community . . ." This is a wide programme involving many issues, some highly controversial; but the broadsheet suggests that "the existing arrangements for maternity and child welfare would provide a foundation" for implementing it, "other provisions being added as they were shown to be desirable and practical". But suppose for the sake of argument that the controversial difficulties had been surmounted

and that the experts were agreed on such subjects as sterilization, abortion and artificial insemination; would not the case for incorporating these paramedical matters into the already existing maternity and health services, rather than vice versa, be overwhelming?

Marriage guidance deals primarily with the personal relationship of two people. It is true that there may be, and often is, a family in the background; but nevertheless it is the personal problems of two partners that are involved, and marriage guidance as such cannot be undertaken merely as part of a larger service for the family. This is not to say that secondary questions such as childlessness and family planning do not come into the picture—they do very often—but they are incidental to the main problem. This is recognized in the Denning Report, which recommends that grant-aid be made to voluntary organisations engaged in marriage guidance. Yet the reasons given in the broadsheet for rejecting the recommendations of the Report do not seem to be convincing; "marriage guidance has such an important function to perform that there would be serious objections to leaving it outside the Family Welfare Service". What the serious objections are is not stated.

One may suggest finally that many couples, though willing that the State should ensure them a safe passage from the cradle to the grave, may prefer to keep their marriage relationships to themselves. This raises the larger question now under consideration by a Home Office committee, on what lines marriage guidance as a form of social service can be most advantageously developed. There is nothing in the broadsheet to indicate that this aspect of the question, namely, State interference in what is perhaps the most intimate personal relationship that exists, has been seriously taken into consideration.

[1] Final Report of the Committee on Procedure in Matrimonial Causes. Cmd. 7024. (London: H.M. Stationery Office, 1947.)

FOOD POISONING

Food Poisoning

Its Nature, History and Causation, Measures for its Prevention and Control. By Elliot B. Dewberry. Second edition. Pp. xii+246+24 plates. (London: Leonard Hill, Ltd., 1947.) 17*s*. 6*d*.

THE subject of food poisoning was once largely a series of disconnected observations and records of outbreaks; but during the last three decades the facts have been associated and the discrepancies and fallacies removed. For example, the old expression 'ptomaine poisoning' has been shown to be without meaning and entirely incorrect. Now it is possible to give a clear account of food poisoning, including the various causal agencies, the paths of infection and the reservoirs of the various bacteria responsible. In the first edition in 1943, the author of the book under notice gave a clearly written account of the subject, and the second edition has brought it up to date. The first edition dealt very inadequately with staphylococcus food poisoning; but this has now been remedied by the addition of a new, separate chapter of 22 pages on this subject which gives all the essential facts. An additional section (appendix I) on laboratory investigation of food poisoning cases is of doubtful utility, as this very technical subject is mainly of interest to the laboratory worker, and for him the account is barely adequate and is available elsewhere.

There are five main types of food poisoning, namely, *Salmonella* infections, toxin outbreaks due to special staphylococci, botulism, poisoning from contamination of the food with poisonous metals and other chemicals, and food poisoning from the consumption of poisonous plants, toxic mushrooms and other fungi, and poisonous fish or shellfish. Each group is separately and adequately treated. Most space is devoted to *Salmonella* food poisoning, which used to be, and may still be, the commonest type in Great Britain, and this is well done. The important recent work on the increase of this type of food poisoning due to the great increase in the use of dried egg mixtures is not mentioned; but this was probably too recent for inclusion.

Botulism is described in great detail, although not more than four outbreaks have ever been recorded in Great Britain. Its deadly nature justifies the detail, for it is more prevalent in some other countries. Food so infected usually shows signs of spoilage, but not invariably. This fact is just mentioned but should have been more emphasized, and the factors explained which determine whether signs of spoilage are or are not present.

The other types of food poisoning are adequately discussed, and no important inaccuracies were detected and few omissions. Examples of the latter are that cadmium poisoning should have been included in the chapter on poisonous metals, the value of the coagulase test is not given in discussing *Staphylococcus* poisoning and that more types of *Clostridium botulinum* are known than those mentioned. These are all small points, and the author has obviously been diligent to keep his book up to date.

The book is frankly a compilation not written by one personally an authority on the subject, but he has included all the essentials, and the volume may be accepted as an adequate and reliable account of food poisoning in its various manifestations. It is attractively illustrated and well printed.

ORGANISATION, METEOROLOGY AND WEATHER PREDICTION

"Here is the Weather Forecast"

By E. G. Bilham. (Binnacle Books Series.) Pp. 220 (36 plates). (London: Golden Galley Press, Ltd., 1947.) 10*s*. 6*d*. net.

WEATHER and the causes of weather are not easy subjects for the writer who addresses himself to a mixed audience. If he aims at strict accuracy, the writing must abound in saving clauses and qualifications, and the result will be anything but a clear-cut picture. Should he largely leave out the qualifying phrases, then the end result will not correspond to reality. Mr. Bilham, in this book, does manage to avoid these two dangers, and gives a clear and highly authoritative account of the way in which weather forecasts are prepared.

The account of the organisation for collecting and distributing weather observations, warnings and forecasts is excellent, and there is much highly interesting information about upper-air measurements by *radiosonde* balloons and the war-time applications of radar to wind finding, and more recently to cloud observa-

tions. The importance of the work of the weather observers on land, on sea and in the air is rightly stressed, and a survey is given of their work and the instruments they use in making routine measurements of atmospheric pressure, temperature and humidity, wind speed and direction, rainfall and cloud height.

The preparation of weather charts and the meaning of the various pressure systems in terms of weather and wind are discussed, and the author valiantly attempts a non-mathematical explanation of Buys Ballot's law, or, strictly speaking, of Coriolis force. This, if a little inelegant because apparently different arguments are applied to meridional and latitudinal motion, serves to indicate the effect, although to a non-mathematical reader the exact variation with latitude will not be readily seen.

The reader is introduced to the extremely important notion of air masses and fronts, which did so much to improve forecasting when first recognized during the First World War and is still the basis of forecasting up to twenty-four hours ahead.

In a book rich with information one hesitates to ask for more; but an account of the different effects on weather of coastal waters, as between winter and summer, and the modifying effects of high ground and long passage overland on cloud and weather, would have been extremely valuable. A man in London hearing overcast conditions and maybe drizzle forecast for south-west England on a fine August morning would then go his way confident that for once the weather is not spreading east.

The principal causes of bad forecasts are lightly touched upon; but many meteorologists would wish that more stress had been put on changes in the weather associated with fronts as they cross Great Britain in particular. After all, if it rains two or three hours after the forecast time, that is a small thing to the man in the street; if it does not rain at all he is little impressed by being told that the warm front passed him exactly on time!

Within the two hundred pages of this book there is a vast amount of information; but the reader is not likely to feel he is being crammed: the frequent plates (there are thirty-six of them in all) and clear line diagrams aerate the text, and Sibley's drawings do much more than illustrate points in the text.

M. K. Miles

MATHEMATICS FOR ELECTRICAL ENGINEERING

Modern Electrical Engineering Mathematics

An Introduction to the Mathematical Methods more Recently Employed in Electrical Engineering Theory, with Special Reference to Stationary Linear Networks. By S. Austen Stigant. Pp. 372. (London: Hutchinson's Scientific and Technical Publications, n.d.) 31*s.* 6*d.* net.

THERE are few branches of mathematics which have not found useful application to electrical phenomena, and the engineer is continually receiving new tools of a theoretical nature to add to his equipment. He has long since had to become familiar with the use of infinite series, with Fourier analysis and with many of the differential equations and functions of mathematical physics. More recently, however, matrix theory and tensor analysis have been added to the list, and the operational methods of approach to circuit problems, including that of the Heaviside calculus, are becoming increasingly important.

In these circumstances, many engineers must be wondering whether it is better to be thoroughly conversant with a limited field of mathematics, so as to be able to make the fullest and most practical use of the knowledge they possess, or to understand in a general way the vast mass of symbolic theory available for their use, with little hope—unless, indeed, possessing an unusual faculty for mathematics—of being really proficient in any of it. There is no general solution to this very real dilemma; it depends upon the individual concerned and upon the degree of specialization within which he works. The author of the book under notice believes that no branch of mathematics likely to have practical application should be neglected by any engineer on the score of its being new or unnecessary: "The advanced engineering theories of to-day become the commonplace practice of to-morrow". It is likely that most engineers would so far agree as to admit the desirability of being at least aware of what analytical methods are available and of their useful range of application.

From this point of view, Mr. Stigant's book is to be welcomed. It deals with a limited number of subjects, having nothing to say concerning differential equations, infinite series or function theory generally, all of which have been discussed adequately before. More than half the book (ten of the eighteen chapters) is concerned with determinants, matrices and tensor algebra; the Heaviside operational calculus, symmetrical components and dimensional analysis in its various forms account for five chapters. The book is thus probably the most comprehensive account of these subjects—with the exception of the operational calculus—that has so far been written for engineers.

The many branches of theory discussed and the large amount of space legitimately and usefully devoted to engineering applications might lead one to anticipate a less detailed treatment than is, in fact, given. On the contrary, a criticism of the reviewer—albeit a minor one—is that in some instances, particularly perhaps in the chapters on tensors, the discussion could be more concentrated. Nevertheless, the writing is careful, and pains have been taken to stress the connexion between the different analytical methods of approach to problems. The original Heaviside method is used in the chapter on operational calculus; the Laplace transform approach is usually preferred nowadays, although the reviewer would agree that, for many, the method adopted in this book would seem a more natural way of introducing the subject. The equivalent of perhaps five chapters is given to examples illustrating the theory, including, among others, the steady state and transient response analysis of networks, three-phase systems, line faults and line protection. Many examples are solved by more than one method.

The book does not make easy reading, which is a fault of the subject rather than that of the author. It could scarcely be recommended as useful reading, however, to anyone who was not already quite familiar with the more usual mathematical methods applied to engineering problems.

There seem to be few errors, and although the production is in conformity with war economy standards, the clarity and lay-out are good. Most useful features are the bibliographies which are given at the end of nearly every chapter. V. J. Francis

ADVANCES IN PHYSIOLOGY

Annual Review of Physiology

Victor E. Hall (Editor), Jefferson M. Crismon and Arthur C. Giese (Associate Editors). Vol. 9. Pp. vii+736. (Stanford University P.O., Calif.: Annual Reviews, Inc.; London: H. K. Lewis and Co., Ltd., 1947.) 6 dollars.

THE "Annual Review of Physiology", though published in the United States, was intended to be international in authorship. It started in 1939 and during the War it had to remain, as it had begun, entirely in American hands. The present volume marks the first appearance of European contributors, who are responsible for five of the twenty-seven articles. Next year we are promised two contributions from the U.S.S.R.

This volume maintains the standard of its predecessors and, as is usual if not inevitable, the articles are of very unequal merit, ranging from the hasty compilation of a catalogue of references, to the personal and critical writing of one who has taken the trouble to digest the data under review. In the latter category are three outstanding contributions of general physiological interest. F. Buchthal, in his article on muscle, summarizes the brilliant contributions which he and Szent-Györgyi have made in elucidating the role of actomyosin and adenosine triphosphate. He also deals fully with the vexed question of the status of acetyl choline in neuromuscular transmission, and covers the advances in electromyography which have resulted from war-time research on peripheral nerve injuries. H. Grundfest, dealing with bio-electric potentials in the nervous system and in muscle, presents a very intelligible review of a subject which to many physiologists has become increasingly obscure. The data are carefully sorted out and correlated; the conflicting theories are precisely defined and then critically analysed. C. J. Wiggers, reviewing the peripheral circulation, gives a characteristic and critical appraisal of some of the newer techniques, such as cardiac catheterization. The main feature of his article is a very thorough discussion of the peripheral resistance, which may well become a classic. Recent work on shock and hypertension is also covered.

In his article on exercise, P. V. Karpovich directs attention to the surprising lack of elementary data in this important and practical subject. Some new physical-fitness tests are discussed, recent work having shown the old tests, such as breath-holding and pulse return after exercise, to be of little value. Workers in several different fields have made the rather surprising discovery that many gross nutritional deficiencies have little or no effect on physical performance of short duration. It is also reassuring to read that rats live longer in an atmosphere of tobacco smoke.

Pathologists will find two articles of particular interest. Writing on defence mechanisms, W. C. Boyd and S. Malkiel review the important work of Menkin, who has isolated various factors—pyrexin, necrosin, leucotaxin—from inflammatory exudates. They also attempt to cover the wide field of antibody–antigen reactions and detoxification mechanisms. S. P. Reimann's article on growth deals chiefly with the pathology of growth and is a most interesting account of attempts which are being made to apply recently acquired biological knowledge to some of the classical problems of pathology. For example, the concepts of induction, evocation and organisers derived from embryology are being applied to the study of mixed tumours. Aberrations of growth resulting from nutritional deficiencies open up a promising field, and the trial of various specific growth-inhibiting substances in the treatment of cancer and leukæmia is interesting, although the results so far have been disappointing.

F. K. Sanders, writing on cutaneous sensation, gives a useful summary of the important work of Woollard and Weddell, most of which was published during the War and is already well known in Great Britain. The physiological effects of heat and cold still require a separate article owing to the considerable amount of war-time research which is still appearing. In this article A. P. Gagge and L. P. Herrington attempt a scientific appraisal of some of the experiments carried out by the Germans at Dachau, and add some appropriate ethical comments. War research still accounts for much of the material reviewed under blood gas transport by D. B. Dill and W. H. Forbes, and also under the respiratory system by H. C. Nicholson. W. Dock, writing on the kidney, devotes less space than usual to consideration of the various 'clearances', which he prefers to call 'ratios', and gives a very welcome review of renal morphology and pathology, especially in its relation to shock and hypertension. Under pharmacology, C. C. Pfeiffer and E. R. Loew deal with the new antihistamine drugs; but most of their article is devoted to chemotherapy and deals with newly discovered chemicals active against fungi, viruses, rickettsia, rodents, war gases and cancer. Two new subjects not previously reviewed are the physiology of supporting tissue by P. D. F. Murray, which deals chiefly with bones and teeth, and the experimental neurosis by H. S. Liddell. The articles on metabolic functions of the endocrine glands by F. D. W. Lukens and permeability by W. Wilbrandt present a vast amount of new information from which no very striking advances seem to emerge.

O. A. TROWELL

BIOLOGICAL APPLICATIONS OF ULTRA-VIOLET AND INFRA-RED RADIATION

Applications of Germicidal, Erythemal and Infrared Energy

By Dr. Matthew Luckiesh. Pp. ix+463. (New York: D. Van Nostrand Co., Inc.; London: Macmillan and Co., Ltd., 1946.) 30s. net.

THE author of this book is the director of the lighting research laboratory of a large electrical firm in the United States and is well known as a prolific contributor to the technical literature of his subject. Much of the material in the present volume has appeared in various technical publications; workers in the field of radiation and its applications will be glad to have the data collected together in a single volume. The scope of the book, the stated object of which is to deal with some major effects of radiant energy, is perhaps sufficiently indicated by the title.

The science of radiation therapy, with which the book is largely concerned, is still in its infancy. Few will dispute the health value of sunlight, although

some may question how far this is of psychological origin or the result of associated fresh air and exercise. The benefits to be obtained from exposure to so-called artificial sunlight are far more open to question. This is only one of the controversial subjects discussed in the book under review—discussed, one may add, in no controversial spirit, for the author states his case with almost evangelical conviction which leaves little room for heretical questioning.

One of the most interesting sections of the book is that dealing with the germicidal effects of ultra-violet radiation. The importance of this subject is now fully established and is well brought out in the excellent symposium on aerobiology published in 1942 by the American Association for the Advancement of Science. In Great Britain experimental germicidal lamps have given good results in certain industrial processes which have to be carried out under sterile conditions. British medical interest in the bactericidal possibilities of ultra-violet radiation has, however, been slow to develop.

The book seems to have been put together hurriedly and is, in consequence, sorely in need of careful editing and vigorous pruning. There is much needless repetition and overlapping; some of the sections, for example, that on ultra-violet energy and plant life, are inconclusive and do not appear to lead anywhere. Too much space is devoted to the author's proposals for systems of units for biological effectiveness of ultra-violet energy analogous to those in use for visible radiation. It may, perhaps, be questioned how far these are justified or will find general acceptance.

Most of the discussions centre around the work of the author and his colleagues; there is, however, a fairly comprehensive bibliography. The various discharge lamps and other artificial sources mentioned are those commonly marketed in the United States, but similar sources are available in Great Britain and elsewhere. Despite its defects, the book should be studied by all who are interested in the biological effects of radiation within the range of the sun's spectrum.

H. G. JENKINS

THE ARGUMENT FROM MOUSE TO MAN

Animal Genetics and Medicine

By Dr. Hans Grüneberg. Pp. xii+296. (London: Hamish Hamilton Medical Books, 1947.) 21*s*. net.

DR. GRÜNEBERG'S new book covers some of the same ground as his well-known monograph on the "Genetics of the Mouse". But the genetic facts he brings forward, although drawn from a narrower field than might be expected from his title, relate to the rodents as a whole rather than to the mouse in particular. His volume provides, in a simple and readable form, the most complete available summary of our knowledge of inherited pathological conditions in this whole group, and will be, for that reason alone, extremely welcome to genetical workers in other fields. As in his previous book, it is a particularly valuable feature that he describes not merely the final adult form of the abnormality, but also as much as is known of its developmental antecedents.

The purpose of the book goes much beyond that of a mere summary. Dr. Grüneberg has written his book in the hope "that it will help to make the geneticist more fully alive to the medical value of his material, and that it will show the medical practitioner that invaluable sources of information are only waiting to be opened up by him". The application which Grüneberg wishes to make of the wealth of factual material he presents is partly at a theoretical level. He shows how the animal geneticist, by the use of controlled breeding, can easily discover whether two apparently rather different abnormalities are, in fact, due to the same ultimate genetic cause. If they are, they may legitimately be considered as two aspects of a single unitary disease. An argument of this type is, the author holds, the only kind which can make possible a logically unassailable classification of the clinical conditions in which hereditary disposition plays a large part. Unfortunately, the crucial test of breeding cannot be applied in a controlled manner to human material; but less direct ways of applying the same concepts are sometimes feasible, and the genetic criterion at least indicates the goal towards which effort should be directed.

The other main advantage enjoyed by the animal breeder is the ability to produce as many animals as he pleases of the pathological strain. This makes it possible to carry out an adequate analysis of the epigenetic processes by which the abnormality is produced. Grüneberg has himself made several noteworthy advances in this connexion, showing, to mention only one example, how a complex of apparently unrelated effects in a certain strain of rats may be traced back to an initial hypertrophy of the cartilage. Such studies are scarcely possible for human material. Indeed, some medical men may be tempted to dismiss them as unnecessary for clinical practice, since there is still a tendency to consider pathological conditions as either physiologically conditioned (when they may be curable), or as hereditary (in which case nothing, it is assumed, can be done to obviate them). Such a view is, of course, indefensible. Grüneberg quotes with approval Sewall Wright's dictum that "the attitude of physiological genetics is that characters are determined 100 per cent by physiological processes, and that genes are the ultimate physiological agents". Genetics has already made an important contribution to the detection and conservative treatment of subclinical diabetes, and it may be expected to render many more such services to therapeutics.

The numerous genetically controlled developmental processes described by Grüneberg have an important bearing on the fundamental biological problem of the mode of action of genes. In discussing these, the author is perhaps not always so convincing as when he is exhibiting the relevance of his material to medical questions. For example, the discussion of whether gene-action is organ-specific or tissue-specific is surely based on a question which does not go deep enough. Some genes, if classified in such terms at all, could only be called organ-specific (for example, aristopedia or bar eye in *Drosophila*); others would appear (contrary to Grüneberg's statement) to affect more than one type of tissue (for example, the 'white' gene in *Drosophila* also reduces pigment in the testis sheath). Surely the true state of affairs is that a gene is specific for one chemical process, which may be involved in one or a number of different tissue- or organ-differentiations.

C. H. WADDINGTON

Elementary Applied Aerodynamics

By Prof. Paul E. Hemke. (Prentice-Hall Aeronautical Engineering Series.) Pp. viii+231. (New York: Prentice-Hall, Inc.; London: Constable and Co., Ltd., 1946.) 26*s*. net.

THIS American volume is essentially a tutorial or class text-book of the type that has not yet made extensive appearance in the field of English aeronautical literature. It treats the subject in logically arranged chapters, each one ending with a number of examples. These are both of the kind that emphasizes the theory already explained, and those giving the technical application of the subject-matter of that chapter. References in these questions to the relevant parts in the discussions, by means of a decimal system of numbering the paragraphs and conclusions reached, make the whole book extremely easy to follow, in a tutorial sense. As an examination crammer it is splendid; whether it is advisable to spoon-feed a student to such an extent is another matter.

The reader will have to take a good deal of the data for granted, especially that given in many of the charts, as reference to the source of the information is not always given. This is, of course, inevitable in a book that attempts to compress the subject into so small a space. It also dates the book rather badly, as the inquiring reader will find it difficult to link up the subject-matter with more recent advances. Aerodynamics is treated in a series of chapters on units, physics of the air, the ideal fluid, viscosity, compressibility, the properties of airfoils, propellers, performance and the helicopter. The author states in his opening remarks that he has dealt with only "the consideration of the more well known and established facts in aerodynamics". The book obviously has been written with the outlook of the exercise class, and in this limited field it can be recommended.

Mathematics of Statistics

By John F. Kenney. Part 1. Second edition. Pp. xii+260. (New York: D. Van Nostrand Co., Inc.; London: Macmillan and Co., Ltd., 1947.) 21*s*. net.

THIS is the first volume of a second edition of a book first published in 1939. The complete book is intended to be an introduction to the more elementary theory and methods of mathematical statistics. The present volume confines its attention almost exclusively to the descriptive theory of statistics. Within this limit, it provides a very carefully and clearly written and admirably printed introduction to the subject, well suited to a student without mathematical knowledge, or working alone. After chapters on the description of frequency distribution by graphical methods, averages, moments and measures of dispersion, the normal distribution is shortly considered, followed by the fitting of linear and quadratic polynomials and the theory of correlation. These subjects are explained with great clarity and at considerable length; but it seems a pity that in so large a book, costing so much, no room was found for an elementary account of sampling and the testing of statistics. As a consequence the student who wishes to decide how much reliance to put on the results of his calculations will have to turn to volume 2 or some other book. This volume by itself is therefore not very useful to a biologist or other experimentalist.

P. A. MORAN

La lutte contre les termites

Par Ch. Noriot et H. Alliot. (Publication de l'Office de la Recherche scientifique coloniale.) Pp. 96. (Paris: Masson et Cie., 1947.) 220 francs.

IT may be said, at the outset, that this publication provides the best short modern account of termites and their control. It is, furthermore, extremely well illustrated and admirably printed on very good paper. The first part deals with the general biology of termites and the outlines of their classification. Part 2 is devoted to the application of various methods for destroying these insects, and Part 3 describes in some detail, and with many structural diagrams, the best methods for protecting woodwork against termite attack, and the special features needed in building construction in guarding against their depredations. Each section is accompanied by a short but adequate list of references to the relevant literature that may be consulted. There is also a list of the various trees stated to be resistant to termite injury.

A. D. I.

Honey Farming

By R. O. B. Manley. Pp. 293+15 plates. (London: Faber and Faber, Ltd., 1946.) 18*s*. net.

MR. MANLEY, who is one of the very few people in the British Isles who can claim to be a honey farmer and to maintain successfully a large number of colonies of bees, is a person whose opinion on all matters relating to bee-keeping is well worth hearing. His latest book, "Honey Farming", is a worthy successor to his earlier excellent and widely read work "Honey Production in the British Isles".

In this new book Mr. Manley draws upon his wealth of practical experience and, in an eminently readable manner, gives some of his ideas about bee-keeping and the methods of management that he is using to-day, relating not only something of his successes but also telling of his failures and how the methods that he is now employing were gradually developed. Needless to say, he thoroughly disagrees with many of the methods still taught and practised by some of the less well-informed bee-keepers, and he does not hesitate to say so, or to criticize severely some of the equipment still advocated for general use. Indeed this book, besides being of inestimable value to those people who wish to learn what a man who has been successful in earning a living from honey production thinks about various systems of management, apiary equipment, bee-breeding, swarm control, queen introduction, and much else besides, will also be a tonic to those who have wished for so long to see the archaic nonsense still talked about bee-keeping exposed.

This is indeed one of the few books about bee-keeping that one can unreservedly recommend, and one that I hope will find a place in the library of every bee-keeper.

C. G. BUTLER

Dairy Farming

Theory and Practice. By V. C. Fishwick. (Agricultural and Horticultural Series.) Pp. 237+55 plates. (London: Crosby Lockwood and Son, Ltd., 1947.) 15*s*. net.

A FEATURE of this book is that about half of it is devoted to concise descriptions of the methods and views of twenty dairy farmers. Six of these farmers are said to be men with a national reputation, seven are well known in their own locality and the

remainder are representative examples of the ordinary farmers of Great Britain. The accounts, which cover a wide range of current practice in dairy farming, are readable and enlightening; and they are illustrated by a useful selection of photographs.

The other half of the book purports to deal with the scientific principles of dairy farming; but this section is singularly rambling for a scientific work and the principles are diluted with platitudes. The diction is sometimes puzzling; for example, when the author states "A skilful breeder will frequently raise a herd of animals that are very similar to the eye". Many of the definitions are inept, and a new agricultural student might be misled by reading that a starchy food is one that contains a small amount of protein.

The general conception of the book and part of the contents are excellent; the style of the remainder will have a limited appeal, but in any case should be read in conjunction with more authoritative works.

S. B.

Birds of the Southwest Pacific

A Field Guide to the Birds of the Area between Samoa, New Caledonia and Micronesia. By Ernst Mayr. Pp. xx+316+3 plates. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1945.) 18*s*. net.

THE south-west Pacific, that is, the area between Samoa, New Caledonia and Micronesia, is a rich ornithological field, many interesting and varied species of birds being found in it. This little book is a field guide to them, its author, Dr. Mayr, having worked for many years on Pacific ornithology. In his introduction he points out that the difficulties and the interest of the task are enhanced by the many separate archipelagos involved, each with its distinct bird fauna, though certain species are common to many if not all the archipelagos. He therefore divides his book into a general section and a geographical section, dealing with the seabirds, shore-birds, and land and freshwater birds of the area in the first part, and taking the faunas of the different groups of islands separately in the latter section. The coloured plates and the black-and-white sketches are helpful and enhance the value of a very useful book.

FRANCES PITT

Archéologie du Pacifique-Nord

Matériaux pour l'étude des relations entre les peuples riverains d'Asie et d'Amérique. Par Dr. André Leroi-Gourhan. (Université de Paris: Travaux et mémoires de l'Institut d'ethnologie, Tome 47.) Pp. xviii+542. (Paris: Institut d'Ethnologie, 1946.) 700 francs.

THIS volume deals with the archæology of the North Pacific in two parts. The first deals with the area generally and with the inhabitants of different regions severally—Japan, the Ainu, Kamschatka, the Eskimo of four different regions, and the Aleutian Islands and British Columbia. In the second part the author takes some fifteen or sixteen implements of common use and widespread occurrence, analyses the various types, and shows their distribution on sketch maps. The Eskimo in particular afford a remarkable instance of an extremely wide distribution of material types, due in part to their possession of a common language and culture, in part to the extremely small and scattered population using the artefacts in question. Life in the North Pacific is necessarily dependent on a highly specialized material culture in which the nature of every tool is strictly determined by the physical environment.

The author comes to the conclusion that it is possible in a sense to speak of a North Pacific civilization, but he rejects any suggestion of a common focus of culture or of the importation of a formed culture from outside the area dealt with. He points out that the remotest period covered by archæological finds cannot be shown to be more than two thousand years ago; that during all that period the population of the area concerned has possessed a comparatively stable physical type; and that the distribution of various types of artefact indicates lines of communication, not of migration. He infers, in consequence, the general danger in archæology of building up theories of migration on the data of typological distribution. Human movement is much less frequent and very much slower than the movements of material culture.

The volume contains a good bibliography of wide range in date and language, a rather poor index, forty-three good maps mostly of distribution, and 1,148 text figures. The work is an important one not only as a study of North Pacific cultures, but also in reference to archæological method in general.

J. H. HUTTON

The Navaho

By Clyde Kluckhohn and Dorothea Leighton. Pp. xx+258+20 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1946.) 25*s*. net.

THE recent increase in the Navajo population and the reduction in fertility of the land in their reservation, consequent upon soil erosion, has confronted them with a serious material problem. Their contact with the civilization of the white man has aggravated this and introduced an equally grave spiritual problem. The Indian Field Service is doing its best to help them; but the policy of moving the administrators from tribe to tribe on promotion prevents them from really getting to know any of the Indians.

This book is one of a series of tribal monographs published on behalf of an Indian Education Research Project sponsored by the University of Chicago and the U.S. Office of Indian Affairs. It deals primarily with Navajo life at the present time, and is designed chiefly to instruct the administrators and teachers who work among these people. The deep concern of the authors for the welfare of the Navajos is shown by it and other books which they have written, and it is a useful, though necessarily limited, study of culture contact, based on intimate knowledge. How far their audience lags behind them is shown by the fact that they find it necessary to insist, at some length, upon such elementary matters as the importance of acquiring at least a smattering of the Navajo language.

That the Navajo word for themselves can be translated 'people' or 'the people' is by no means an isolated phenomenon, so the frequent reference to them as The People, which recurs throughout the book, is an irritating mannerism. The production of the book is up to the high standard which we expect of the Harvard University Press, and it is illustrated by some admirable photographs.

G. H. S. BUSHNELL

SCIENTIFIC ASPECTS OF THE WORK OF THE NATIONAL COAL BOARD

By JOHN CROSSLAND
Department of Mining, University of Leeds

Introduction

UNDER private ownership, only a few of the larger colliery companies in Britain had laboratories and research departments, and apart from an effort to control the standard of coal preparation, little real scientific investigation was carried out by the colliery companies themselves; at any rate, judged by present-day standards, it was totally inadequate. To some extent, various research organisations—largely sponsored by the Mining Association—compensated partly for this deficiency; but, here again, the scale of attack was not large enough.

When the Miners' Welfare Committee came into being and a levy of 1*d.* per ton of output was arranged, some of this money was used to create the Safety in Mines Research Board. Work carried out by this Board was directed towards increasing the health and safety of those employed in the coal mines of Britain, and much useful work was accomplished. Naturally, the aim was to improve working conditions, study safety appliances and generally to find ways and means of reducing the number of accidents.

There was also the British Coal Owners' Research Association, where some work was done on mine atmospheres, suppression of dust, drilling and spontaneous combustion; but the staff was never large.

Just prior to 1939, the British Coal Utilisation Research Association, to which the Mining Association subscribed most generously, commenced work on a number of programmes connected with the efficient utilization of coal for both domestic and industrial purposes. This organisation was able to assist the various industries in many ways during the war period. It must be remembered that when the National Coal Board took over the vast mining industry of Britain, it did so at comparatively short notice and with almost no preparation for the gigantic task before it. Some of its plans are now being made known, and among them it is not surprising to find that the Coal Board proposes to develop a scientific department in the fullest sense.

Although the organisations mentioned previously were doing useful work before January 1, 1947, it was obvious that considerable expansion would be necessary as deeper, dirtier and more difficult seams were mined. An increase in the amount of mechanization will take place, with a consequent increase in the use of power, both on the surface and underground. Therefore, research should be directed towards obtaining a solution to the many problems that will occur, so that plans for the changes can be formulated well ahead, in order to obtain the highest standard of efficiency in all branches of mining work.

In the various coalfields, there has existed for many years, and usually attached to a university department of mining, a coal survey laboratory. These laboratories were financed by the Department of Scientific and Industrial Research, for the purpose of making chemical analyses and physical examinations of the seams in the area and for providing information of national importance in connexion with the future working of the coal seams. The results of this work have been available to all colliery companies in the past, and the National Coal Board has taken over these laboratories as a going concern, to be placed under the direction of the scientific member of the Board.

Status of Scientific Department

The National Coal Board decided, from the commencement of its existence, quite rightly, that science should be brought into the mining industry in the fullest sense, and that it should be represented at the highest level. It was not surprising, therefore, to find that Sir Charles Ellis had been appointed as the scientific member of the Board. This was decided so that a scientific approach could be made to all problems, whether under the heading of control or research. It is intended that a scientific organisation shall be built up to become an integral part of the industry, and not something quite extraneous to it.

A divisional 'chief scientist' has been appointed in each division, that is, each coalfield approximately, not as a member of the divisional board, but as an adviser to it. The divisions are split up into areas, and in each area there is a 'scientist' and a staff, so that it will be possible to provide a comprehensive scientific service, which will be at the disposal of the area general mines manager. In time, modern laboratories and equipment will be available in all coalfields, and, when the necessary staff can be obtained, much useful work may be accomplished in a field where there is a wide scope for work of this kind. Eventually, at the divisional level, laboratories will be available, with a specialist staff, to tackle problems which are beyond the resources of the area laboratories, and which are of special interest to the particular division. In this connexion, it should be mentioned that each coalfield has its own particular problems; for example, South Wales, production and suppression of dusts which cause pneumoconiosis; Staffordshire, Warwickshire and South Yorkshire, spontaneous heating and gob fires; West Yorkshire, working thin seams; north of England, preparation and cleaning of gas coals.

There are many problems which are found in all coalfields: pit heap fires, treatment of effluents, testing of suggested new analytical methods, the routine examination of the prepared coal and coal preparation problems generally. Routine scientific work includes analysis of coal, mine air, mine dusts, cokes, oil and metals, physical tests on coal, analysis and treatment of water (particularly for boiler plants and in some instances for domestic use).

In an effort to decentralize the scientific control service, it is intended that the day-to-day work of control should be determined by the division, in accordance with standard methods and standards of accuracy laid down by the Board. This is so that laboratories will be similar in status, arrangements and staff. A 'director of scientific control' has been appointed to co-ordinate the work in the various divisions.

As mentioned previously, the national coal survey has been transferred to the Coal Board, and the laboratories will co-operate with the divisional scientific organisations, with the Geological Survey and with the Fuel Research Station at Greenwich.

National Research Directorates

Many of the research problems concern all the coalfields of Britain, and therefore cannot be investigated at divisional level. In order to obtain the maximum of efficiency, the full weight of the headquarters staff will be necessary to deal with these problems. Provisionally, three research directors have been appointed at national level: (*a*) chemical, (*b*) medical, (*c*) physical. Under (*a*), much of the long-term research will be on the 'physics and chemistry' of coal, the carbonization and manufacture of special fuels and the development of chemicals from the by-products of coke and gas. The majority of this work will be carried out at Newcastle and in South Wales, and will be co-related with that of the British Coal Utilisation Research Association, where work is being done on the efficient utilization of coal. Under (*b*) the chief problem will be the health of the miner. The present director is a physician, and in the first place investigation will be made on such occupational diseases as pneumoconiosis, nystagmus, dermatitis, rheumatism, beat-hand and beat-knee. There are in existence organisations which have already carried out some work on these diseases; but much can be done by co-ordinating their efforts, and in the dissemination of knowledge obtained. Very often the latest information never reaches the miner, who, like many men employed in rather rough and tough jobs, tends to be careless about his health. Statistics relating to diseases and accidents will be examined, and special men and collieries will be selected for experimental purposes, as these problems have to be considered from the medical, physiological and operational points of view. An effort is being made to recruit an adequate and properly qualified staff.

General Research

It is important that all questions of a fundamental character which affect underground working conditions should be investigated. In the first place, the 'director of general research' is concentrating on mine dusts and illumination. With regard to the latter, for example, it is necessary to produce lighting of a character which is suitable for different coal faces. Pneumatic fluorescent lamps are being tried, and, generally, mine lights of numerous types are being studied in relation to the various methods of working, which include the use of many classes of machinery. It is obvious this work has considerable bearing on the prevention and alleviation of certain diseases such as pneumoconiosis and miners' nystagmus. The National Coal Board has taken over all the liabilities of the Mining Association with regard to research, and therefore becomes the largest subscribing member of the British Coal Utilisation Research Association. Sir Charles Ellis has been elected president and chairman of the council of the Association. This will allow of the necessary liaison between these large organisations and will ensure that all research work on coal will be co-ordinated, and much overlapping of programmes of research thus avoided. In order to facilitate the interchange of ideas between the Board and the research organisation, the scientific member's deputy—the director-general of research—has been made responsible for the efficient organisation of the scientific aspect of the Coal Board's work, and a small staff will be engaged on routine administration, so that the scientific workers employed will be free from restrictions of this kind.

The ground work has been accomplished, and much of the machinery created for the scientific study of the British coal industry's problems; but it is premature yet to look for major results. There is unlimited scope for the Scientific Department when it is properly equipped and staffed.

THE FUTURE OF THE NEW FOREST

THERE is probably no part of England which is the subject of more general interest than the New Forest. Everyone in the country has become acquainted as a child with at least one historical fact associated with the New Forest, and has since acquired some information—probably inaccurate—as to the real significance of both parts of its name; even if he has never visited it, he feels that it is part of the national heritage which should be preserved as such.

Those who live in or near the Forest, those who know it well as visitors, and those who have some part to play in its use and maintenance, have naturally all been keenly interested in the effect modern developments and ideas are having or may in future have on it; and the result has been a series of official publications on these subjects—as well as numerous unofficial reports and papers—of which the latest is the "Report of the New Forest Committee, 1947"*. The Committee in question was appointed by H.M. Forestry Commission in April 1946, "to investigate the state and condition of the New Forest and, having due regard to existing rights and interests, to recommend such measures as they consider desirable and necessary for adjusting the Forest to modern requirements". The membership of the Committee should be noted, comprising a distinguished representative each of the English National Committee of the Forestry Commission, of the Council for the Preservation of Rural England, and of the Forestry Commission itself, under the chairmanship of the Right Hon. H. T. Baker. From the list of eighty-four witnesses heard, it is evident, despite one or two gaps, that every effort was made to hear all informed and interested points of view—and incidentally the Committee met no fewer than thirty-five times.

The two committees responsible for the previous reports of 1939 (Report of the Committee of Planning Officers, 1938–39, H.M.S.O.) and 1945 (Planning Officers Report; Planning Committees Revision, 1945; New Forest Advisory Planning Committee, Lyndhurst) were primarily composed of representatives of the local government authorities most concerned, and dealt specifically with the protection of the New Forest as related to local and regional planning. The deputy-surveyor, Mr. D. Young, has served on all three committees, and much of the credit is due to him for the very considerable measure of success attained in reconciling rather conflicting views and interests, and the significant improvement of the relations between the major interests which has been brought about in recent years.

This is perhaps not the place to examine the legal aspects of the problem, important and interesting though they are; but it must be noted that the present situation is mainly governed by the New

* Forestry Commission. Report of the New Forest Committee, 1947. Pp. 104. (Cmd. 7245.) (London: H.M. Stationery Office, 1947.) 3s. 6d. net.

Forest Act of 1877, many clauses of which are shown to be in need of clarification or revision. It has also to be realized that since 1923, when the management was handed over from the Office of Woods to the newly constituted Forestry Commission, the Forest has ceased to be Crown property. Appreciation of the value of the Forest from the point of view of recreation and enjoyment can be traced back to 1868 at least, and in 1928 it was declared in Parliament that amenity should be the chief object of management, and positive steps were taken to ensure outstanding appropriate treatment of areas of interest, with the help of an advisory committee.

A matter which has long been the subject of the keenest interest and concern is the enclosure of parts of the area for forestry purposes. Out of the total area of 92,365 acres, 64,707 are Crown Lands, and at the time of the Deer Removal Act (1851) it was agreed that the enclosures might total 20,000 acres, this figure being afterwards reduced to 16,000. The actual areas enclosed were not fixed in perpetuity, but only the maximum area that may be enclosed at any one time, so that an area successfully stocked with trees might be thrown open and an equivalent area elsewhere taken in. The present position is that 15,745 acres are enclosed and the balance of 255 may only be taken up within 1,927 acres which, though now unenclosed, have been enclosed in the past. An interesting historical point is that enclosures to protect young coppice were expressly provided for so long ago as an Act of 1483, and 6,000 acres were actually so enclosed in Elizabethan times. It should be noted that there are 5,000 acres of unenclosable forest—the ancient unenclosed woods—and more than sixty square miles or 40,000 acres of open heath; but at the moment no less than 8,700 acres, out of an even larger area occupied during the War for Service and other purposes, have not yet been released. The timber also suffered very heavily during the War, but there has been generally favourable comment on the smallness of the damage to the amenities by these unavoidable fellings.

Turning to the specific recommendations, it is proposed that the framework of the time-honoured administrative organisation should be maintained, authority being in the hands of the Council of Verderers, with the Court of Swainmote exercising its judicial functions, but it should be reorganised to suit it better to modern requirements. A strong case is made out for constituting the whole Forest area into a single rural district committee, which with the Borough Committee of Lymington should be the planning authority for the Forest.

In the 'inclosures', natural regeneration and group planting should be preferred to large-scale plantations, broad-leaved species favoured, and the coniferous blocks duly screened. The Committee thinks it desirable that the verderers should agree with the Forestry Commission for further enclosures of up to 5,000 acres of land valueless for grazing but suitable for planting without harming the amenities. It is recognized that owing to absence of regeneration the ancient unenclosed woods are gradually dwindling; and to remedy this, powers are recommended to enclose and restock small areas not exceeding twenty acres together, throwing them open again as soon as the new trees are out of danger from grazing stock. This is considered an important matter, and the Committee would like to see not less than fifty acres dealt with annually in this way.

Various proposals are made in connexion with the commoners, aiming at clearing up points in doubt under existing legislation and at furthering their interests. A progressive step suggested as advisable and practicable is to make the whole area a 'tuberculin-tested' area.

A recommendation which is supported by various good arguments but which may not be acceptable to all concerned is the acquisition by the Forestry Commission of the adjacent commons, aggregating no less than 6,300 acres, to be controlled and administered by the verderers as part of the 'open forest'.

Scientific men will look with special interest to the recommendation for the preservation of the whole Forest as a nature reserve under the control of the verderers acting through a specially appointed qualified curator. The difficulties involved in making sure of adequate protection of flora and fauna against an unheeding public and the unscrupulous collector of rarities are squarely faced, and proposals are made for meeting them; if adopted, the necessary powers will be there, but only time will show how effectively they can be used. It is good to note that the basic necessity of habitat preservation is recognized and leads to specific warnings against extensive heath burning and against draining certain bogs: the Committee somewhat optimistically finds "nothing irreconcilable in the competing claims made on behalf of nature lovers and holiday makers".

Some further modernization of the roads, notably a modern twin trunk road across the Forest from Cadnam to Ringwood, is inevitable. The Committee has some useful suggestions as to how to do what is necessary with minimum loss of amenity, and there are sound proposals dealing with such matters as advertising.

In this review, much of interest and importance in an excellent and comprehensive report has unavoidably been passed over. It is to be hoped that the report will be widely read and carefully considered, and that helpful criticism will be made so that the new New Forest Act which should be enacted before long will be able to take into account not only the views that have been put before the Committee during its inquiry but also views it did not hear and the reactions to the conclusions it has reached.

H. G. Champion

THE STATUS OF THE PROTOZOA

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I

THE purpose of this article is to consider whether the Protozoa are to be regarded as cells and whether the animals so named form a natural group.

The Cell as a Unit

In order to decide whether a given object is or is not a cell, it is necessary to have definite ideas as to the meaning of that word. The cell is often described as a *unit*, without any adequate account being given of what is unitary in its nature. One of the most evident facts about the cell is that its characteristic component is protoplasm, the self-perpetuating and synthesizing substance of organisms. While allowing that this word has no absolutely precise meaning, we

must acknowledge that there are many substances of which it can be stated with certainty that they are not protoplasm, and that such substances occur commonly between cells, but never constitute cells; while protoplasm exists in cells (and in transformed cells). These facts are generally agreed, whatever view may be taken of the cell-theory as a whole.

There is, however, nothing unitary about the idea of protoplasm. Two separate or separable masses of this substance correspond qualitatively, in virtue of their chemical composition, but need not correspond in any numerical sense. The idea that a cell is a unit, and that different cells thus correspond numerically, must be based upon the existence of something that can be counted. The most obvious objects that suggest the unitary nature of the cell are the centriole, the nucleus and the nucleolus, all of which usually occur only once in each little mass of protoplasm. The centriole, as is well known, has a tendency to divide long before cell-division, and the nucleolus is not always single; but when all these objects are in fact single, the cell is in its most characteristic unitary form.

The chromosomes provide even better evidence of the unitary state. The cell is most clearly a unit when the nucleus has originated by the telophase transformations of one *set* of chromosomes. The haploid cell is clearly a unit, and all haploid cells correspond with one another and deserve a single name. Owing, however, to the existence of sexual reproduction in organisms, there is a necessary alternation between the haploid and diploid conditions. Haploid and diploid cells are the fundamental components of most organisms; they succeed one another in regular alternation in the germ-plasm of the great majority, generation after generation. The diploid cell, from its possession of a single nucleus and other unitary characters, can indeed be regarded as a unit; but the haploid cell is the most perfectly unitary component of organisms. One could, if one wished, suggest a decreasing order of unity in cells, as one passed from haploid to diploid, triploid, tetraploid and polyploid cells of various degrees of chromosome multiplication. Since, however, no naturally occurring organism has more than two parents, and since cells usually divide when the number of chromosomes has become doubled by division, it is reasonable to make rather a sharp distinction between the haploid and diploid states on one hand, and states in which the number of chromosomes is greater than $2n$ on the other. This distinction may reasonably and conveniently be marked by restricting the word 'cell', when used without qualification, to cases where the haploid or diploid condition is realized. The phrase 'transformed cell' may be used when an object that has possessed the characters of a cell becomes so changed as no longer to possess them—as, for example, when the number of chromosomes is increased beyond the diploid condition. Under this terminology a cell would become a transformed cell if chromosome reduplication occurred within the nucleus, or the nucleus divided mitotically without cytoplasmic division; and a *Vaucheria* could be regarded as an extreme form of transformed cell. It may be remarked that the reverse change occurs when, for example, a tetraploid transformed cell becomes diploid, in the course of evolution, by differentiation of the chromosomes.

The fact that there is usually only one nucleolus in diploid cells is related to the activities of the chromosomes. A nucleolus usually begins to form at one locus only on each of only one pair of homologous chromosomes, and the two nucleoli so formed commonly fuse.

No constantly occurring cell constituent beyond those already mentioned seems to provide evidence of unitary nature. The mitochondria and the components of the Golgi apparatus are too inconstant in number to provide reliable criteria. The unitary concept of a cell has, however, been attacked by those who have laid stress on the existence of various self-perpetuating bodies within a cell and have suggested that these are the real units. These arguments have been answered by Bourne[1], who has argued, with justice, that there are no smaller particles within cells, that are to the cell as the cell is to the multicellular organism. As he says elsewhere[2], "Cells are the ultimate vital units . . . *they* are the Lebensträger, or biophors, and there are no living individuals lower than cells".

It has been suggested that the word 'cell' has practical usefulness but only vague validity, like the word 'species'. Now the invalidity of the word species is evident from the following considerations. If an evolving organism were seen by systematists at two periods of its history, geologically remote, it would necessarily be regarded as belonging to two different species (or genera or larger groups); and if every intermediate stage were known, it would be impossible to get the concurrence of systematists as to the exact stage at which the new species was to be regarded as separate from the old. No difficulty of this kind arises in connexion with the use of the word cell, as applied to many-celled organisms (except in special cases in which, for example, tetraploidy gives place to diploidy in the course of evolution, by chromosome-differentiation). The word cell can be used with a precise and valid meaning. *A mass of protoplasm, largely or completely bounded by a membrane, and containing within it a single nucleus formed by the telophase transformation of a haploid or diploid set of anaphase chromosomes, is a haploid or diploid cell.* The presence of a single nucleolus and (at the moment when the mass of protoplasm first originated by the division of a preceding one) a single centriole would be confirmatory evidence.

Unicellular Protozoa

It follows from this definition that a great number of Mastigophora, Amœbina, Heliozoa, and Sporozoa (*sensu stricto* = Telosporidia of Schaudinn) are single cells, which alternate between the diploid and haploid condition (though nuclear unaccompanied by cytoplasmic division occurs, of course, in some forms at certain stages of the life-history). In many cases the chromosome cycle is accurately known. It has, indeed, been claimed that there are structural differences showing that the supposed cells of Protozoa are not cells, and attention has been directed in particular towards the intranuclear centrosome and spindle. The centrosome is, however, by no means always intra-nuclear in Protozoa. The extra-nuclear basal granule of flagellates is generally regarded as the counterpart of a centriole. Again, the centrosomes of the trophozoite of the gregarine, *Monocystis rostrata*, are extra-nuclear, and an extra-nuclear spindle is formed between them[3]. In the terrestrial amœba, *Hartmanella klitzkei*, the centrosome is extra-nuclear, and the nuclear membrane disappears during mitosis[4]. Arndt gives a list of Protozoa in which extra-nuclear centrosomes have been described.

Many Protozoa display the characters of a cell so well that it is not easy to understand how it can be denied that they are unicellular. The question whether certain Protista may be regarded as unicellular is, indeed, a subject of dispute among zoologists only; botanists are almost unanimous in considering that this is obviously so. Among the algæ, several distinct groups are *each* represented by species that are motile holophytic single cells, by other species that are motile colourless single cells, by others again that are motile, dendroid or palmelloid colonies, and by yet others that are simple or heterotrichous filaments (see especially Fritsch[5]). If the word 'metaphyte' is to be used as the botanical equivalent of 'metazoon', then one can say that metaphytes have unquestionably arisen more than once among the algæ. A metazoon is characteristically an animal in which there is *more than one kind of somatic cell*. This is exactly the condition in heterotrichous filaments among algæ. Now the heterotrichous *Stigeoclonium* is allied to the unicellular *Chlamydomonas*, and the heterotrichous *Dinoclonium* to the unicellular *Gymnodinium*. Conditions are particularly clear in *Dinoclonium*[6]. This is a brown marine alga that spreads as a filament over other algæ, and sends out upright lateral filaments. Single cells of the main thread become modified as swarmers, which escape from their cell-walls and swim freely as typical dinoflagellates resembling *Gymnodinium*. One cannot escape the conclusion that each swarmer is a cell, with the necessary consequence that *Gymnodinium* is a cell—a fact that will be allowed by botanists, though it contradicts those zoologists who altogether deny the cellular nature of Protozoa.

From these facts it follows that the Protozoa cannot be regarded as monophyletic: they include motile representatives of algæ belonging to various groups, many members of which are clearly not Protozoa in the ordinary sense since they are multicellular, non-motile and holophytic. To take a concrete example: *Gymnodinium* is very much more closely related to *Dinoclonium* than to *Amœba*. It is therefore wrong to include *Gymnodinium* and *Amœba* in a single group (Protozoa) which excludes *Dinoclonium*. The word Protozoa is not valid in the evolutionary or true classificatory sense, though it may be used descriptively. No precise definition will cover all organisms that are regarded as Protozoa and exclude all that are not, but the following covers all the typical ones: "Organisms that are motile and/or holozoic, and in which different kinds of somatic cells do not occur"; but it is necessary to add to these such organisms as are obviously related to those that are covered by the definition, but themselves escape it. The strict definition does not cover the Amœbosporidia (= Neosporidia), in which there is a differentiation of more than one kind of somatic cells (pole-capsule cells and envelope cells).

Non-cellular Protozoa

It will be noticed that in the proposed definition, no mention is made of Protozoa being unicellular. This is because there are many Protozoa that are not cells, in the sense in which the term has been defined above (p. 549). The Radiolaria provide some of the best examples. The careful work of Borgert[7,8] on *Aulacantha scolymantha* shows that a huge number of 'chromosomes' (more than 1,600) appear at division of the 'nucleus'. Very large so-called nuclei are usual in the group. There is no question of a meiotic division of these large nuclei, with the production of gametes containing half as many chromosomes. On the contrary, both the gametes and the non-sexual isospores contain only minute fragments of the large nuclei. The process varies in the different forms, but chromatin is often cast out into the cytoplasm and small portions of the cytoplasm are nipped off round these. The process of nuclear break-up has been described in detail by Brandt[9] for *Thalassophysa pelagica*. From the central capsule, with its single, huge 'nucleus', there develop thousands of small individuals, each with many nuclei. Although the number of chromosomes in the gametes and in the nuclei of the small individuals is not known in most cases, yet it is clear that the large 'nucleus' of the feeding stage is enormously polyploid, or 'polyenergid', as Hartmann[10,11] called it. The idea of the polyenergid nucleus occurred to him when he first saw an apparently uninucleate *Thalassophysa* change into a colony of thousands of small individuals, each with several nuclei, as Brandt had previously described. It is obvious that a radiolarian, with its enormously polyploid 'nucleus', does not correspond with a diploid or haploid metazoan cell (though it may correspond with the polyploid protoplasmic masses that occur in certain tissues of certain metazoan species).

Polyploid or polyenergid 'nuclei' occur also among the Foraminifera and in *Wagnerella* among the Heliozoa. It is probable that so-called 'chromidia' are commonly the actual *nuclei* of polyenergid forms. Further, it is among polyenergid Protozoa that amitosis is generally found. Amitosis is very difficult to understand if it ever occurs in a diploid or haploid protozoan, for it would seem likely to play havoc with the gene-complex. If, however, there is in fact a very large number of nuclei in one large 'nucleus', there is no reason why exact division should be necessary. The nuclei of polyploid protoplasmic masses in Metazoa may perhaps sometimes divide amitotically in a similar way.

Wherever new nuclei are formed from chromidia or a large nucleus divides by amitosis, polyploidy is to be suspected, and a direct comparison with a diploid or haploid metazoan cell cannot be made with any confidence. Highly polyploid Protozoa may, however, be less usual than one is inclined to suppose. The largest Protozoa are the easiest to study and much the easiest to demonstrate to elementary students; and the largest Protozoa are the most likely to be polyploid and therefore the least likely to be typical of the group as a whole. It is perhaps significant that when *Amœba proteus* undergoes mitosis, a large number of chromosomes appears[12].

The Ciliophora present a problem of their own. The so-called protociliates, such as *Opalina*, are obviously multinuclear; the other members of the group possess one or more macronuclei, the exact significance of which is still obscure. The micronucleus is unquestionably diploid until meiosis occurs at the beginning of conjugation. Two or more micronuclei are present in various ciliates of different groups; but the majority have only one, and the question is whether such forms can be regarded as diploid cells. The hypothesis that seems to fit the facts best is that the macronucleus, whether obviously multiple or not, represents a polyenergid nucleus. Races of ciliates lacking the micronucleus have been bred in several species; *Oxytricha fallax* has lived through 246 generations in this condition[13]. Amicronucleate specimens present the characteristic complex structure of the species and appear to be able to perform all normal functions except endomixis and

conjugation (which they sometimes attempt unsuccessfully). It must be assumed, therefore, that they possess the complete gene-complex. A normal ciliate, therefore, is at the very least triploid. Since, however, the macronucleus divides by 'amitosis', it is probably highly polyploid; otherwise serious changes in the gene-complex would result from such a rough method of division. As is well known, various ciliates may be divided mechanically, and each half or lesser portion will show that it possesses a complete gene-complex by regenerating into a normal individual. In some forms there is no distinct macronucleus, but only a mass of small granules of chromatin; each of these may perhaps represent a nucleus.

If this argument be correct, the Ciliophora must not be compared with the diploid and haploid cells of Metazoa, but rather with the polyenergid Radiolaria and other evidently polyploid Protozoa.

(To be continued)

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THE ARTIFICIAL PRODUCTION OF MESONS

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RECENT reports[1] from the United States announce that E. Gardner and C. M. G. Lattes have observed that mesons are generated when α-particles of great energy are allowed to fall on matter. The α-particles were produced by the 184-in. synchrocyclotron at Berkeley, California, the mesons being detected by the photographic method. Most of the experiments have been made by the bombardment of carbon; but in similar conditions, targets of beryllium, copper and uranium yield mesons in approximately the same numbers.

The experiments show that the production of mesons becomes appreciable when the energy of the α-particles is of the order of 300 MeV., and the yield rises rapidly with increasing energy. By observing the deflexion of the mesons in the field of the cyclotron magnet, it is possible to determine the sign of the electric charge and the value of $H\rho$ of the individual particles. The momentum of a particle can thus be determined; and this quantity, taken in conjunction with its observed range in the emulsion of the photographic plate used for detection, gives a measure of its mass. The mean value so obtained is $(313 \pm 16)\, m_e$, where m_e is the mass of the electron. The authors state that in view of the large number of tracks available for measurement, it will be possible, in the near future, to reduce the errors of the determination to the order of $\pm$ 2 per cent. Up to the present, no measurements have been made of the mass of the positive mesons by this method.

A large proportion of the negative mesons which stop in the emulsion produce nuclear disintegrations with the emission of heavy charged particles. On the other hand, the positive particles, at the end of their range, produce no nuclear disintegrations, but a large fraction of them give rise to secondary mesons. These results, taken in conjunction with recent determinations of the mass of cosmic ray mesons, make it certain that at least a large proportion of the artificially produced particles are identical in type with the heavy mesons recently discovered at Bristol[2,3].

In these latter experiments, two types of heavy mesons were distinguished: σ-mesons, which produce nuclear disintegrations at the end of their range; and π-mesons, which decay with the emission of a secondary μ-meson. It was suggested that the π-mesons, and most of the σ-mesons, are respectively positive and negative particles of the same type; and, in view of their observed production during the explosive disintegration of nuclei, that they have a strong interaction with nucleons.

This view has been confirmed by Goldschmidt, King, Muirhead and Ritson[4]. These authors, working at Bristol, have determined the mass of the particles by studying the small-angle scattering which they undergo in passing through the emulsion. The value thus obtained is $(270 \pm 40)\, m_e$, for both π- and σ-mesons. Further, the quantity m_π/m_μ, the ratio of the mass of the π-meson to that of the secondary μ-meson produced by its decay, has been determined by Lattes, Occhialini and Powell[5], using the method of grain-counting. The value thus obtained is $m_\pi/m_\mu = 1{\cdot}65 \pm 0{\cdot}15$. If it is assumed that the μ-mesons are identical in type with the charged penetrating particles of the cosmic radiation, of mass $200\, m_e$, the above result corresponds to a value of $m_\pi = 330 \pm 30\, m_e$. The masses of the heavy mesons observed to be produced artificially, and of those in the cosmic radiation, are therefore equal to within the limits of error of the experiments. In view of the points of similarity in their behaviour when brought to rest in the photographic emulsion, it may be taken as established that the two classes of heavy particles, observed in the two experiments, are identical.

Experiments with heavy cosmic-ray mesons[5] have shown that the half-value period associated with the decay of these particles, τ_π, is greater than $0{\cdot}4 \times 10^{-10}$ sec. Preliminary observations indicate that the time of flight of the particles in the cyclotron experiments, assuming them to originate in the target material and to proceed to the photographic plate without suffering spontaneous decay, allows this limit to be reduced to about 10^{-9} sec. This result is consistent with the value $\tau_\pi < 2 \times 10^{-8}$ sec., deduced by Marshak and Bethe[7] from the absorption curve of the penetrating component of the cosmic radiation at great depths.

In addition to the production of heavy mesons, the Berkeley cyclotron experiments also provide evidence that light mesons, with a mass of about $200\, m_e$, are created in the bombardment of matter by α-particles of great energy. Preliminary observations suggest that some of the negative particles of this type, at the end of their range in the emulsion, also produce disintegrations.

The 184-in. cyclotron was designed and constructed with the view of generating mesons artificially; but until recently it was thought that the fast particles it produces were not sufficiently energetic for this purpose. From the point of view of meson production, an α-particle of energy 400 MeV. was considered to be approximately equivalent to four nucleons, each of energy 100 MeV.; and such a nucleon has not sufficient energy to lead to the creation of a particle of rest-mass 300 m_e. In contradiction with this view, the observations show that the generation of mesons occurs when the kinetic energy per nucleon is about 75 MeV., and indicate that the production process must be considered in relation to the α-particle as a whole.

It is pointed out by Gardner and Lattes[1] that it is possible to reconcile the observed production of mesons with the view that they are created in interactions between individual pairs of nucleons, if, following a suggestion of McMillan and Teller[6], account is taken of the internal motion of the nucleons in the colliding nuclei. Suppose the internal kinetic energy of the nucleons, in an α-particle or in a carbon nucleus, to be 25 MeV. For the production of mesons, it may be assumed that the most favourable collisions will be those in which the relative velocity of pairs of nucleons has the greatest possible value. The maximum kinetic energy available in the centre-of-mass co-ordinate system of a pair of nucleons in such a collision will then be equal to $\frac{1}{2}(\sqrt{100} + \sqrt{25} + \sqrt{25})^2 = 200$ MeV.; a value more than sufficient for the creation of a particle of mass 320 m_e. The same approach suggests that the threshold for the production of mesons by α-particles should occur at an energy of ~ 300 MeV. The observations are thus consistent with the simple assumption that the mesons arise as a result of an interaction between single pairs of nucleons.

These experiments establish the possibility of investigating the properties of mesons in laboratory conditions, with localized sources of particles of high intensity. It is reasonable to suppose that they will lead to a period of rapid advance in nuclear physics, especially in the development of our knowledge of the internal motion of the nucleons, and of the forces between them which give stability to the nuclei. They represent a technical advance of decisive importance, and the progress of the investigations will be followed with great interest.

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NEWS and VIEWS

Holweck Prize: Prof. Y. Rocard

THE Holweck Prize and Medal were founded in 1945 as a memorial to Fernand Holweck, director of the Curie Laboratory of the Radium Institute in Paris, and to other French physicists who met their death during the occupation of France in 1940–44. The award, made jointly by the Physical Society and the Société Française de Physique, is conferred alternately upon a French and an English physicist. This year the Prize and Medal are awarded to Prof. Yves Rocard, professor at the Sorbonne, and director of the Physics Laboratory of the École Normale Supérieure, University of Paris. During 1925–39 M. Rocard published many papers on the equation of state of gases, hydrodynamics, diffusion of light by liquids, the optics of the atmosphere, mechanics, acoustics, and the propagation of electromagnetic waves. He introduced molecular hypotheses into the equations of hydrodynamics; he rediscovered the classical equations, determined the state of the liquid in the capillary layer which separates it from the vapour, and developed the theory of surface tension. These detailed studies of the structure of liquids enabled Rocard to determine the mechanism of the diffusion of light by an exact calculation of the intermolecular field, and to give the classical theory of the Raman effect. In connexion with these investigations, he carried out a series of theoretical and experimental studies of the transparency of the atmosphere, the range of projectiles and the visibility of signals.

This period of Rocard's scientific life was followed, from 1930 until the War, by ten years of work on acoustics, the mechanics of oscillating systems, and the mechanics of fluids; he studied the stability of motion of locomotives, the possibility of self-sustained oscillations in a centrifugal pump, and the damping of vibrations in the wings of aircraft. At the beginning of the War, Rocard put his knowledge at the service of his country, especially his work on critical frequencies of self-oscillation in aircraft, and the increase of sensitivity of sound detection apparatus. During the occupation of France, he occupied his enforced leisure in compiling a book on the general dynamics of vibrations; this has been translated into English and published in the United States. At the beginning of 1943 Rocard escaped from France and joined the Free French Forces in England. He adapted British and American radar to French ships, and took part in the liberation of Corsica and the capture of Toulon.

Engineering at the National Physical Laboratory: Mr. D. G. Sopwith

MR. D. G. SOPWITH has been appointed superintendent of the Engineering Division of the National Physical Laboratory in succession to Dr. G. A. Hankins, who recently became director of mechanical engineering research in the Department of Scientific and Industrial Research. Mr. Sopwith has been on the staff of the Engineering Division of the National Physical Laboratory for about twenty years, and his main interest has been in research on engineering materials and in the application of the basic principles of elasticity to engineering design problems. Until 1938 he worked in collaboration with Dr. H. J. Gough on fatigue and corrosion fatigue of metals, and on the design of lifting gear such as crane hooks. The former work showed the effect of the atmosphere on the fatigue resistance of various metals, while the latter resulted in improved practical designs. During the War, Mr. Sopwith carried out important work on the design of gun springs, gun barrels and shells; but his most valuable contribution was on the penetration of shot into armour plate, and his work both analytically and by controlled experiment in a laboratory armour-penetration range has done much

to place that hitherto empirical subject on a sounder scientific basis. Mr. Sopwith brings to his new task, not only research experience, but also a marked ability to appreciate and then simplify analytical methods so that they can be readily applied to practical problems of engineering design.

Economics at the University of Sheffield : Dr. G. P. Jones

Dr. G. P. Jones, reader in economic history in the University of Sheffield, has been appointed professor of economics in the University, in succession to Prof. D. Knoop, who retires in September. Dr. Jones is no stranger to Sheffield or Sheffield people, for he has been a member of the University staff since 1926 when he was appointed lecturer in economic history, and in recognition of the distinction of his scholarship and research the University conferred upon him in 1946 the title of reader. He has been especially interested in the organisation of the building industry from medieval to early modern times, to which field he has made distinguished contributions. In addition, ever since he has been in Sheffield, Dr. Jones has been closely connected with adult education, and throughout the whole period April 1940–July 1946 he did great service to the cause of education in H.M. Forces as secretary to the Sheffield Regional Committee, under the auspices of which more than twelve thousand lectures and classes were held for members of the Army, the R.A.F. and Women's Auxiliary Forces.

Royal Geographical Society : Awards for 1948

H.M. the King has approved the award of the Royal Medals for 1948 of the Royal Geographical Society as follow : *Founder's Medal*, to Mr. Wilfred Thesiger, for his contributions to the geography of southern Arabia and for his recent crossings of the Southern Arabian desert, the Rub al Khali ; *Patron's Medal*, to Mr. Thomas H. Manning, of the Geodetic Survey of Canada, for his explorations and survey work in the Canadian Arctic, including the mapping of Southampton Island and the Foxe Basin shores of Baffin Island, and for his successful adaptation of Eskimo methods of travel. The Council of the Society has made the following awards : *Victoria Medal*, to Prof. Frank Debenham, professor of geography in the University of Cambridge, for his work in geographical education and for his contributions to polar geography and exploration in the Antarctic and as first director of the Scott Polar Research Institute at Cambridge. *Murchison Grant*, to Mr. Robert W. Steel, lecturer in Colonial geography at the University of Oxford, for geographical work on the West African Ashanti Social Survey, 1945–46. *Back Grant*, to Mr. Alan J. Marshall, for exploratory and scientific work as leader of the Oxford University Exploration Club Expedition to Jan Mayen Island, 1947. *Cuthbert Peek Grant*, to Dr. Donald F. Thomson, for his explorations and anthropological studies in Arnhem Land, Northern Territory, Australia. *Gill Memorial*, to Mr. William W. Williams, lecturer in geography at the University of Cambridge, for original research during the War on the determination of underwater beach gradients.

Royal Asiatic Society of Bengal : Medal Awards

The following medal awards of the Royal Asiatic Society of Bengal were announced at the annual meeting held on February 16 : *Barclay Memorial Medal*, a biennial award for contributions to medical or biological science with reference to India, to Rai Bahadur K. C. Mehta, principal of Agra College, for his contributions to the study of "Cereal Rusts in India" ; *Joy Gobind Law Memorial Medal*, a triennial award for contributions to the study of zoology in Asia, to Dr. Lieven Ferdinand de Beaufort, professor of zoology in the University of Amsterdam and director of the Zoological Museum at Amsterdam, for his contributions to the study of "Fishes of the Indo-Australian Archipelago" ; *Paul Johannes Bruhl Memorial Medal*, a triennial award for contributions to the study of Asiatic botany, to Prof. S. R. Bose, professor of botany, Carmichael Medical College, Calcutta, for his original research on polyporin from fungi ; *Dr. Bimala Churn Law Gold Medal*, an annual award for contributions to Indological studies, to Dr. B. M. Barua, professor of Pali in the University of Calcutta, for his contributions to the study of Buddhism in India ; *Sir Jadunath Sarkar Gold Medal*, a newly instituted biennial award for contributions to Indological researches from the thirteenth century A.D. up to A.D. 1802, to Sir Panduranga S. S. Pissurlencar, for his contributions to the study of the history of the Marathas and the Deccani Muslim Powers down to the time of Tipu Sultan.

Council for 1948

The members of Council of the Society for 1948 are as follows : *President*, Dr. W. D. West ; *Vice-Presidents*, Dr. B. C. Law, Maharajadhiraja Bahadur Sir U. C. Mahtab, Dr. M. N. Saha, Sir B. L. Mitter ; *General Secretary*, Dr. K. N. Bagchi ; *Treasurer*, K. P. Khaitan ; *Philological Secretary*, Dr. S. K. Chatterji ; *Joint Philological Secretary*, Dr. M. Ishaque ; *Natural History Secretaries*, Dr. K. Biswas (biology) and Dr. S. K. Mitra (physical sciences) ; *Anthropological Secretary*, Dr. Verrier Elwin ; *Historical and Archæological Secretary*, H. Waddington ; *Medical Secretary*, Lieut.-Colonel C. L. Pasricha ; *Library Secretary*, Dr. B. S. Guha ; *Other Members of Council*, C. C. Blagden, H. F. Bensly, Dr. A. H. M. Mohiyuddin, Sir A. H. Ghuznavi and Ramaprasad Mookerjee.

The following were elected fellows of the Society : Rao Bahadur K. V. Rangaswami Aiyangar, director of public instruction, Travancore ; Dr. B. M. Barua, professor of Pali, University of Calcutta ; Dr. F. G. Percival, of the Tata Iron and Steel Co. Prof. D. R. Bhandarkar, formerly of the University of Calcutta, was elected an honorary fellow.

Corrosion Research in Canada

The National Research Council, Canada, has established a committee to assemble information on all aspects of corrosion and promote its dissemination. In the first instance, a survey is being made of existing Canadian facilities for the study of corrosion and means of combating its effects. It is proposed to assist Canadian universities in making studies of the fundamental chemical and electrochemical reactions that cause deterioration of metals in service, and in the training of students in the techniques of corrosion research and prevention. In the development of a programme of research in this field the committee is seeking the co-operation of all organisations and industries that are concerned in dealing with corrosion problems, and to obtain information a questionnaire has been prepared and given wide distribution.

The chairman of the new committee is Dr. R. R. Rogers, Department of Mines and Resources, and the secretary is D. Wolochow, Division of Building

Research, National Research Council, Ottawa. Other members of the Committee are: H. J. Butterill (International Nickel Co.), N. Cohen (National Research Council), R. Judge (Department of National Defence, representing the Defence Research Board), Frank D. Forward (University of British Columbia), H. P. Godard (Aluminium Laboratories, Ltd.), Lorne Sproule (Imperial Oil Ltd.), Dr. C. Y. Hopkins (National Research Council), E. T. Hurley (Canadian National Railways), H. D. Smith (Nova Scotia Research Foundation), and Frank Twining (Canadian Industries, Ltd.).

'Supermalloy': a New Magnetic Alloy

IRON-nickel alloys, containing 35–90 per cent nickel, have permeabilities very much greater than that of iron. These alloys, called 'permalloys', are especially useful commercially for transformers. The addition of one or more of the elements molybdenum, chromium and copper to permalloys has proved advantageous. 'Mumetal', which contains usually 5 per cent copper, 2 per cent chromium, 75 per cent nickel and 18 per cent iron, is perhaps the best known of the permalloys. It is used in transformers suitable for high frequencies and is notable not only for its high initial permeability (between 10,000 and 30,000) and its high electrical resistivity (60 microhm. cm.) but also for the very simple heat treatment required in its preparation. O. L. Boothby and R. M. Bozorth have described recent developments in these high-nickel alloys for use at low inductions (*J. Appl. Phys.*, **18**, 173; 1947; see also Bozorth, R. M., *Rev. Mod. Phys.*, **19**, 38; 1947). The new material 'Supermalloy' (su-perm'-al-loy), developed during the Second World War and already supplied in considerable quantities to the U.S. Navy, contains 5 per cent molybdenum and 79 per cent nickel, the remainder being mainly iron with a little manganese. The alloy is heat-treated, being maintained at 1,300° C. in pure dry hydrogen and then cooled from 600° C. to 300° C. at a critical rate. Whereas its electrical resistivity is about the same as for 'Mumetal', its initial and maximum permeabilities are many times larger, 50,000–150,000 for the initial, and 600,000–1,200,000 for the maximum, permeabilities. 'Supermalloy' can be produced in the form of very thin insulated tape, suitable for transformer cores, and it is claimed that the use of this new alloy in communication transformers permits a threefold increase in the range of frequencies transmitted, and a pulse duration three times that previously obtained.

Colchicine, its Chemical and Biological Properties

THE sessional inaugural lecture to the Chemical Society of University College, Dublin, was delivered on February 3 by Prof. J. W. Cook, regius professor of chemistry, University of Glasgow, who spoke on colchicine. Colchicum, a drug of great antiquity, is extracted from meadow saffron (*Colchicum autumnale*). It is present in all parts of the plant, especially in the seeds, which contain up to 0·75 per cent of the active principle. The poisonous nature of colchicum was known to Dioscorides; its toxic symptoms and its only therapeutic use, in the treatment of gout, are described in "The Herball", by John Gerarde, published in 1597. Colchicine, the active principle of colchicum, was isolated by Pelletier in 1820, but was not obtained pure and crystalline until 1915. Its composition and its functional groups were investigated by Zeisel, and the main features of its molecular structure were established by Windaus in 1924. Colchicine, $C_{22}H_{25}O_6N$, contains three rings, one of them a trimethoxylated benzene ring, an acetylamino group, and an inert carbonyl group, and it is the methyl ether of an enol. Recent studies have shown that revision of the Windaus structure is necessary, and the molecular formula of a degradation product, deaminocolchinol methyl ether, has been established beyond doubt by Barton, Cook and Loudon (1945). The final details of structure of colchicine itself still require to be settled. The molecule probably contains at least one seven-membered carbon ring. The remarkable effect of colchicine in arresting mitosis in nuclei at the metaphase was discovered by Lits, a pupil of Dustin; it is effective in a dilution of 1 in 10^8, and has important biological applications. Thus, it may be used as an index of the rate of growth of tissues, and of the activity of various classes of growth-stimulating hormones. An effect on plants, first studied by Havas, was shown by extensive investigations of Blakeslee to result in the production of polyploidy, leading to new and improved varieties of flowers, fruits and cereals.

Insect Pests of Flour

UNDER the title of "Insect Pests of Food: The Control of Insects in Flour Mills" (London: H.M. Stationery Office. 7*s.* 6*d.* net), the Ministry of Food has recently issued a useful 84-page practical bulletin by J. A. Freeman and E. E. Turtle. The authors are, respectively, chief entomologist and chief chemist of the Infestation Control Division of the Ministry. The bulletin deals with those insects and mites that affect the flour miller: it describes the measures that can be adopted in order to prevent infestation and how to control such insects should they manage to establish themselves. It is divided into three main sections, namely, methods of prevention and control; life-histories of insects and mites; and infestation in the mill. The losses which these creatures inflict on the industry may be assessed as damage to wheat; interference with productive processes; contamination and spoiling of finished products and loss of goodwill and trade reputation. The methods of control that are described are only those which have been examined by the Ministry and thoroughly proved in practice. It should not be inferred, however, that these methods are in any sense static. New work is continually going on, and, as examples, may be mentioned that which is being done in assessing the value of D.D.T. and of benzene hexachloride ('Gammexane') in this connexion. The bulletin is very well illustrated by numerous half-tone plates and text-figures.

The Bird Watcher

THE company of bird watchers grows larger with succeeding years, its ranks including a diversity of enthusiasts, from the scientific ornithologist to the schoolboy and schoolgirl recruit. It is to help these latter that the *Daily Mail* has issued a number of booklets on Nature subjects and so on, the latest of its School Aid series being "Bird Watching" by Mr. Stuart Smith (2*s.*). This consists of some thirty-four pages of excellent advice on how to study birds, with a number of admirable photographs by Mr. Eric Hosking, supplemented by equally admirable drawings by Mr. Edward Bradbury and eight colour pictures, the latter being reproductions of plates from Gould's "Birds of Great Britain". It is wonderful how fresh in spirit and treatment the Gould bird portraits remain, while for accuracy of feather detail

they are hard to beat. With regard to the letterpress, Mr. Stuart Smith's advice on bird-watching will be very helpful to young people, especially his hints on identifying birds in the field; in short, his book is not only a good addition to the School Aid series, but is to be recommended for any boy or girl who shows an inclination for bird study.

The Caribbean Commission

THE Caribbean Commission, instituted by the Governments of France, the Netherlands, the United Kingdom and the United States, has published its first annual report (Port of Spain: Caribbean Commission. London: Crown Agents for the Colonies). From the scientific point of view its most important work is that of the Caribbean Research Council. The Commission is a consultative and advisory body fully representative of all the Colonies (islands and mainland) in the Caribbean area. Its Research Council is specially concerned with scientific, technological, social and economic problems. After its war activities, concerned largely with provision and distribution of food to the various Colonies, the Commission and its various committees are now again getting down to work. Problems of forestry, livestock, grain crops and grassland have been investigated or are under investigation. The Commission has also been concerned with the transference of West Indian agricultural labour to the United States.

Ray Society: Annual General Meeting

THE hundred and fourth annual general meeting of the Ray Society was held on March 17. It was announced that Pennant's "Tour on the Continent 1765", edited by Prof. G. R. de Beer, would be published shortly as part of the issue to members for 1947, and other volumes relating to the British fauna and flora are in active preparation, including Prof. Berrill's work on the Tunicates, Mr. Dandy's volume on British vice-counties, Messrs. Locket and Millidge's "British Spiders", the late Prof. W. M. Tattersall's monograph on the Mysidacea, and a second volume of Prof. Balfour-Browne's "British Water Beetles". The greatly increased cost of printing is likely seriously to hamper the activities of the Society, and an urgent appeal is made for new subscribers—both institutions and individuals. Prof. G. R. de Beer, Mr. A. C. Townsend and Dr. Errol White were re-elected president, honorary treasurer and honorary secretary respectively; Capt. C. Diver and Dr. W. S. Bristowe were elected vice-presidents and Dr. Malcolm Smith, Dr. John Hutchinson, Major Maxwell Knight and Dr. Ethelwynn Trewavas new members of council.

Summer School in X-Ray Crystallography

A SUMMER SCHOOL in fundamental and applied X-ray crystallography will be held in the College of Technology, Manchester, during September 6–17. The course will be conducted by Dr. H. Lipson, Dr. H. E. Buckley and other members of the staff of the University and the College of Technology. During the course emphasis will be laid upon fundamentals such as the analysis of the basic types of X-ray photograph, and enough detail will be given to enable the student to deal with more advanced types by himself; in addition, directions of practical application will be indicated. It is hoped that, by these methods, students will have received a clear outline of the application of X-ray methods in general and that they will thus be able to assess its value to their own researches in particular. Applications to attend the course should be sent to the Director of Extra-Mural Studies, University, Manchester 13, and must be received not later than May 12.

Announcements

WE regret to announce the death of Prof. Alfred Lacroix, For.Mem.R.S., permanent secretary for thirty-four years of the Paris Academy of Sciences, on March 16, aged eighty-five; and of Prof. E. Waymouth Reid, F.R.S., professor of physiology at University College, Dundee, during 1889–1935, on March 10, aged eighty-five.

THE honorary degree of doctor of laws has been conferred by the University of Aberdeen on Sir George Thomson, professor of physics, Imperial College of Science and Technology, London; and on Major-General D. N. Wimberley, principal of University College, Dundee.

ON the occasion of the installation of Lord Halifax as chancellor of the University of Sheffield on July 2, the honorary degree of doctor of laws will be conferred on the following: The Hon. Lewis W. Douglas, Ambassador for the United States of America; Mr. Anthony Eden; Lord Addison; Admiral of the Fleet Lord Cunningham; Sir Frank Stenton, vice-chancellor of the University of Reading; Sir Henry Tizard, chairman of the Advisory Council on Scientific Policy; and Mr. Ernest S. Graham, Lord Mayor of Sheffield, 1946–47.

DR. V. PETROW, lecturer in chemistry at Queen Mary College, University of London, has been appointed chief research chemist to the British Drug Houses, Ltd., London, in succession to Dr. W. Bradley, who has accepted an invitation to the chair of colour chemistry and dyeing in the University of Leeds.

A PRELIMINARY meeting with the view of the establishment of a Scottish Society of the History of Medicine will be held in the Library of the Royal College of Surgeons, Edinburgh, on April 23, at 5 p.m. Dr. Douglas Guthrie will make a statement regarding the constitution and object of the proposed Society, and a paper by Dr. Henry J. C. Gibson on "The Early Days of Dundee Royal Infirmary" will be read. Communications should be sent to Dr. Douglas Guthrie, 21 Clarendon Crescent, Edinburgh.

THE National Research Council of Canada has established post-doctorate fellowships in pure chemistry tenable in its laboratories in Ottawa. The normal stipend will be 2,820 dollars, but may be varied depending on the qualifications of the candidate. A travelling allowance may be made. The awards are tenable for a period of one year but may be renewed for a second year. The subjects for investigation include photochemistry, radiation chemistry, spectroscopy, organic chemistry, radioactivity, low-temperature investigations, surface chemistry, and the properties of gases at high pressures and temperatures. Information and application forms may be obtained from the Chief Scientific Liaison Officer, Canada House, London, S.W.1.

ERRATA. In the note on the Max Planck Society in *Nature* of March 20, p. 427, the president's name should have been Prof. Erich Regener; misprints also appear in the names of Prof. Georg Schreiber and Prof. Heinrich Wieland.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Distribution of Alkaline Phosphatase in the Eggs of a Sea-urchin

In a paper presented before the Sixth International Congress of Experimental Cytology at Stockholm, 1947, J. Runnström[1] remarked: "I find it reasonable to assume that the activation of the development means the activation of a number of enzyme systems". Starting from this assumption, I have studied the distribution of alkaline phosphatase in oocytes, mature unfertilized and fertilized eggs of the sea-urchin *Paracentrotus lividus* Lm. The material was collected during the summer of 1947 at the Station Biologique, Roscoff, Finistère.

The eggs were treated according to the histochemical methods elaborated by Gomori[2,3] and by Takamatsu[4]. The substrate contained sodium glycerophosphate and calcium chloride together with veronal buffer. The *p*H of this mixture was approximately 9·4. With this method, the sites of phosphatase activity appear black.

The results obtained may be summarized as follows.

(1) *In oocytes.* The phosphatase is localized in the nucleolus and the nuclear membrane (see Fig. 1). The cortical layer is devoid of phosphatase.

(2) *In mature unfertilized eggs.* A uniform layer of granules present in the cortex gives a strong phosphatase reaction (see Fig. 2). In all probability, these are identical with the cortical granules, which contribute to the material of the fertilization membrane (cf. refs. 5, 6). The peripheral part of the nucleus also contains phosphatase.

(3) *In fertilized eggs.* The quantity of alkaline phosphatase is considerably greater than in the mature unfertilized egg. The enzyme is present in numerous granules evenly distributed throughout the cytoplasm (see Fig. 3). There is thus no particular accumulation of the enzyme in the cortical layer. The extensive activation of alkaline phosphatase following the fertilization is accomplished within a few minutes after the attachment of the spermatozoon.

There is thus a pronounced difference with respect to quantity and distribution of alkaline phosphatase in oocytes, unfertilized and fertilized eggs of *Paracentrotus lividus*. The phosphatase activity appearing in the cortex after the maturation may be one of the factors on which the fertilizability of the egg depends.

The strong activation of cytoplasmic phosphatase in the fertilized egg is in harmony with the profound modifications which the proteins undergo upon fertilization (cf. ref. 1). It is tempting to suggest that the activation of the phosphatase is in some way correlated to an increased nucleic acid metabolism.

Several aspects of this work are now being continued. A more detailed report will appear elsewhere.

My sincere thanks are due to Prof. John Runnström, who suggested this subject to me, for his help and active interest.

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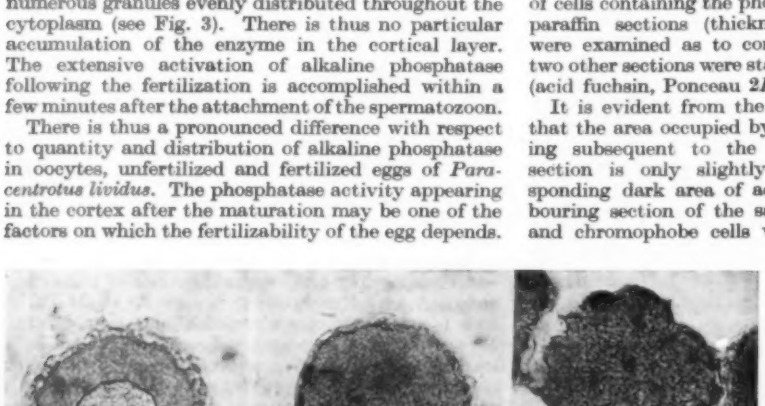


Paracentrotus lividus Lm. EGG CELLS FIXED AND STAINED BY THE GOMORI FIXATION TECHNIQUE. (1) OOCYTE, (2) MATURE UNFERTILIZED EGG, (3) FERTILIZED EGG FIXED 45 MINUTES AFTER INSEMINATION

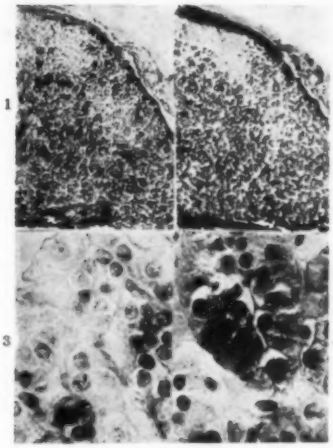
In (1) and (2) the cells are surrounded by a coat of jelly much distorted by fixation and embedding. The cytoplasm of the oocyte and of the mature unfertilized egg is much better preserved by cold alcohol than that of the fertilized egg; cf. the irregular contour of the latter (3). This gives supplementary evidence of the profound alteration of the cytoplasmic fabric occurring upon fertilization

Alkaline Phosphatase in Various Cell Types of the Anterior Pituitary of the Guinea Pig

Only small amounts of alkaline phosphatase have hitherto been found in mammalian endocrines. It was, however, possible to demonstrate considerable quantities of this enzyme in the anterior pituitary lobe of both the male and the female guinea pig. After fixation of the glands in 96 per cent alcohol, in 80 per cent alcohol, in acetone or in pyridine-alcohol[1], the Gomori technique[2] was used. As already known, the nuclei of the anterior pituitary show a positive reaction which, however, has not been localized to any particular cell type[3]. In order to identify the type of cells containing the phosphatase, every two of four paraffin sections (thickness: 2–4 μ) of each gland were examined as to content of phosphatase: the two other sections were stained by Masson's trichrome (acid fuchsin, Ponceau 2*R* and aniline blue) method.

It is evident from the photomicrographs (p. 557) that the area occupied by the black product appearing subsequent to the dephosphorylation in the section is only slightly smaller than the corresponding dark area of acidophile cells in the neighbouring section of the same gland. The basophile and chromophobe cells which occupy most of the peripheral area as well as the smaller basophile and chromophobe islets within the interior area exhibit no, or very slight, enzymatic reaction.

In acidophile cells, the strongest reaction is given by nuclei and cell surface; but in many cells the cytoplasm also shows a high phosphatase content. In such cases the enzyme is either diffusely present within the whole cell, or localized around the nuclei, or mainly concentrated in the centroplasm- (Golgi-)



PHOTOMICROGRAPHS OF FRONTAL SECTIONS OF THE CRANIO-LATERAL REGION OF THE PITUITARY OF PREGNANT FEMALE GUINEA PIG. FILTERS: TRICOLOUR GREEN AND COMPLEMENTARY BLUE

(1) Dark, alkaline phosphatase reaction area. (2) Corresponding dark area of Masson-stained acidophile cells in the neighbouring section; black connective tissue on the surface of the gland (both sections × 30). (3) Peripheral portion of phosphatase-exhibiting section; light basophile cells, dark nuclei of acidophile cells (× 400). (4) A group of acidophile cells with diverse phosphatase contents in the cytoplasm (× 400)

field, a localization found also in the intestinal epithelium[4]. The nuclei of the acidophile cells either contain large black granules or stain diffusely[3]. The highest content of enzyme was observed in the pituitary of the pregnant female. In all the glands examined a smaller number of acidophile cells was found where the phosphatase activity was confined to the nucleolus or the nuclear surface. When a group of acidophile cells in different stages of functional activity was examined, the amount of enzyme was found to vary considerably. I propose to extend the present work by following the changes of enzyme content in the different stages of secretion.

It is already clear, however, that there is no direct correlation between the enzyme content and the quantity of acidophilic granules present. The question is not yet settled whether there is a distinct qualitative (or only a quantitative) difference, so far as phosphatase activity is concerned, between the acidophile cells on one hand and the basophile and chromophobe cells on the other. Possibly the slightly blackened cells present in the light area of sections treated by Gomori's method do not correspond to basophile or chromophobe, but to acidophile cells in a stage of low phosphatase activity. It is of interest that the presence of alkaline phosphatase is correlated with the occurrence of ribose nucleic acid, the presence of which in acidophile cells of the guinea pig pituitary[5] we were able to confirm. In the hypophysis of advanced embryonic stage the phosphatase was mainly found in the nucleolus and in different parts of the nucleus, but rarely in the cytoplasm. This localization may agree with Caspersson's conception of the protein synthesis[6] in the young secretory cell as well as with observations on other secretory organs[7].

From a preliminary investigation of the hypophysis of the rat, it appears that the enzyme and the ribose nucleic acid contents are low. Our observations on operated animals lead us to believe that there is a quantitative difference between the rate of hormone production in guinea pigs and rats.

In the bovine hypophysis the acidophile cell produces the lactogenic hormone and the growth hormone, whereas the basophile cell produces the FSH, the LH and the thyrotropic hormone[8]. The same probably holds true in the case of the guinea pig (at least as regards the gonadotropic, the thyrotropic and the growth hormones)[9]. In the light of the evidence presented above, it may be inferred that the production of pure protein hormones[10] in the acidophile cell of the anterior lobe of the pituitary of the guinea pig is somehow related to high alkaline phosphatase and ribose nucleic acid content, while the production of hormones of the glycoprotein type (as well as of the adrenotropic hormone[8], which is a pure protein) in the basophile cell occur under enzymatic conditions different from those found in the acidophile cells.

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Influence of Vitamin P (Vitamin C_2) upon the Amount of Ascorbic Acid in the Organs of the Guinea Pig

WE have put forward previously the view that vitamin P acts upon vitamin C as a 'sparing factor' by slowing down its oxidation; this factor should be indispensable, for without it the organism would need vitamin C in much larger quantities than can be supplied by a normal diet[1]. This theory led us to carry out two series of experiments. The first showed that various substances capable of raising the mean capillary resistance of a group of guinea pigs decrease *in vitro* oxidation of *l*-ascorbic acid[2]. The other showed that *l*-ascorbic acid, administered to guinea pigs, even in large doses and over a long period, is inefficient if the animals are given at the same time a diet deficient in an ascorbic acid economizing factor. Conversely, if vitamin P is added, *l*-ascorbic acid, even in small doses, becomes fully efficient; vitamin P alone, without ascorbic acid, has no effect. The tests used were the mean capillary resistance of a group of guinea pigs and the histological picture of the thyroid gland and of the cortico-adrenal gland[3].

It then became a question whether vitamin P would be able to increase the amount of ascorbic acid present in the organs, if the quantity of ascorbic acid administered in the diet was kept constant.

Tests were made with twenty male guinea pigs weighing about 300 gm. In a preliminary period of eleven days, the animals were given a diet with

MEAN QUANTITIES OF ASCORBIC ACID IN MGM. PER 100 GM. OF ORGAN

		I	II	III	IV
Liver	*a*	1·9	2·9 (1)	3·4 (3)	20·0
	b	4·0	< 4·4	< 2·6	12·3
	c	< 0·6	0·9	< 1·0	5·0
Spleen	*a*	3·4 (3)	3·8	6·2 (2)	18·2 (4)
	b		< 2·0		12·9
	c	< 3·5 (3)	1·7	< 4·1	8·5
Kidney	*a*	3·8	1·4	2·0	20·3
	b	4·2	1·8	< 3·4	9·5 (2)
	c	< 0·8 (3)	0·6	< 2·1	4·8
Adrenals	*a*	6·7 (3)	10·2	< 5·3 (3)	33·5
	b				30·9
	c	< 3·9	< 3·9	< 3·4	13·5

Diets: I—Basic diet (4 guinea pigs).
II ,, ,, + catechin*: one mgm. per animal daily, orally (2 guinea pigs).
III ,, ,, + *l*-ascorbic acid; 10 mgm. per animal six days a week, orally (5 guinea pigs).
IV ,, ,, + *l*-ascorbic acid and catechin in the doses given above (5 guinea pigs).

Techniques: *a* Direct measurement with dichlorophenolindophenol following Tillmans.
b Kinetic measurement with dichlorophenolindophenol following Meunier.
c Kinetic measurement with methylene blue following Géro.

When a measurement had not been made on all animals of a set, the number of animals which were submitted to this measurement is indicated in brackets.

* A mixture of epimers of the *d*-catechin (Percapyl Roussel).

plenty of ascorbic acid and vitamin P (cabbages *ad lib.*). Then they were divided into four sets of five animals. The diet of each set is given in the accompanying table.

The basic diet consisted of a mixture of equal weights of oats (var. *grignonnaise*, which proved, during preliminary experiments, to be without obvious effect upon capillary resistance) and bran, autoclaved at 110° C. with ammonium hydroxide for half an hour. In addition, each animal was given daily orally 1 mgm. aneurine, 0·5 mgm. riboflavine, 1 mgm. nicotamide, and twice weekly 1 cm.³ cod liver oil.

In groups I and II, the mean weight of the animals decreased from about the eighteenth day. It remained almost stationary in groups III and IV. In group I, one guinea pig died on the eighteenth day and two others were dying on the twenty-third day. In group II, one animal died on the eighteenth day and two others on the twenty-second day. No animals died in groups III and IV. All survivors were killed by bleeding, groups I, II and III on the twenty-third day, group IV on the twenty-sixth day. Measurements were made of the amount of ascorbic acid present in the organs of the animals which had survived until the twenty-third day.

Autopsy and histological examination demonstrated the presence of scorbutic type lesions in all animals, with the exception of those in group IV.

The measurements of ascorbic acid present were made after extraction with a saturated solution of ammonium sulphate, following the technique of Mentzer. The mean figures obtained are given in the table. Three techniques were used: (*a*) direct measurement with dichlorophenolindophenol; (*b*) kinetic measurement with dichlorophenolindophenol, following the technique of Meunier[4]; (*c*) measurement with methylene blue, following the technique of Géro[5]. It will be noted that the three techniques give rather different figures; but two points should be noted: (1) Each technique gives for the same organ amounts four to eight times larger in Group IV than in the other groups. (2) This difference cannot be ascribed to over-estimation of the amount of ascorbic acid due simply to the presence of catechin; for Géro[5] showed, and we have confirmed, that the addition of catechin either to an extract of an organ or to a pure solution of *l*-ascorbic acid does not affect the results given by Meunier's technique and even reduces those given by the methylene blue technique.

It follows from this experiment that (*a*) there is no storage of ascorbic acid when guinea pigs receive ascorbic acid without a 'sparing factor' of this substance; (*b*) catechin, alone, does not appear to alter the amount of ascorbic acid in the organs of guinea pigs which are given, during twenty-three days, a scorbutic diet; (*c*) the simultaneous supply of *l*-ascorbic acid and catechin leads to storage of a certain amount of ascorbic acid. Histochemical detection of ascorbic acid was positive only in the organs of the animals of group IV.

These observations show the manner of action of vitamin P; they explain why a higher level of storage of ascorbic acid is reached in the organs when the animals are supplied with natural sources of vitamin C than when they are supplied with pure synthetic *l*-ascorbic acid. The latter observation is in agreement with the figures published by Giroud, Leblond, Ratsimamanga and Géro[6]. More generally speaking, it seems impossible to study any action of ascorbic acid on the living organism without having determined previously the amount of the 'sparing factors' of ascorbic acid present in the diet.

In general, our work on the physiological role of this factor is in agreement with the hypothesis formerly put forward in France so early as 1926 by L. Randoin and R. Lecoq and by Bezssonoff. Bezssonoff gave the new substance the name 'factor C_2', and we think it would be advisable to return to that term. This would have the advantage of avoiding any confusion with vitamin PP, and, above all, it would recall the physiological role of this factor, which is not restricted to an effect on vascular permeability.

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The Nucleolus of the Apodan Sertoli Cell

THE association of desoxyribose nucleic acid with the nucleolus has been reported in a number of different types of cells. Hydén[1] in nerve cells, Davidson[2] in the rat liver cell and Koller[3] in tumour cells, find that particles or granules giving a positive Feulgen reaction occur on the periphery of the Feulgen-negative nucleolus. Caspersson[4] has identified these granules with what he calls "nucleolus-associated chromatin". He assigns to them the important function of the secretion and deposition of nucleolar substances and a part in protein synthesis in the cytoplasm. Koller and Davidson believe that this nucleolus-associated chromatin forms an integral

part of the nucleolar structure and contributes to the formation of the chromocentre and the nucleolar organisers.

Recently, while examining the Sertoli nuclei in the testis of certain Apoda (Amphibia), it was observed that the nucleolus showed Feulgen-positive granules adhering to its periphery. The nucleus of the Sertoli cell in *Siphonops annulatus* has one or more nucleoli and each of them shows a distinctly dual structure. Around the spherical nucleolus (which is Feulgen-negative) there occur a number of Feulgen-positive bodies; two to six bodies could be counted on a single nucleolus. They were larger than the granules figured by Hydén in the spinal ganglion cell of the rabbit and nearly as conspicuous as those found by Koller in the resting tumour cell treated with stilbœstrol.

The possible function of these bodies cannot yet be defined, since the function of the Sertoli cells is itself a matter of doubt in the Apoda. In these Amphibia, the Sertoli cells have undergone a great change in position as well as structure, and there is every reason to believe[4] that the usual function of providing support and nourishment to the growing sperms, assigned to the Sertoli cell of the vertebrate testis, could not hold in the case of these Amphibia. But it is a matter of great significance that unlike the tumour cell which enters on division, the Sertoli cell has no mitotic future and is to be regarded as one which has reached a stage of permanent rest[6]. In this respect the Sertoli cell resembles rather the nerve cell or the liver cell, where also mitoses are rare or wanting. It therefore appears unlikely that these granules could take part in any process associated with mitosis. The other possibility of the synthesis of cytoplasmic proteins, suggested by Caspersson, would also appear to be untenable in the Sertoli cell, where the cytoplasmic equipment is very meagre or often altogether wanting, the nucleus lying naked in the periphery of the testis locule[5]. It would therefore appear that the function of these Feulgen-positive bodies on the nucleolus is linked up with the general function of the Sertoli cell itself, which, in the Apoda, is at the moment obscure. Efforts are being made to determine these functions.

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A Cytochemical Study of the Perinuclear Lipidic Layer in the Liver Cell

The blackening by osmium tetroxide of the perinuclear layer in various animal cells is well known (see, for example, Hirschler[1]). Recently, with an electron microscope, Gessler and Fullam[2] investigated guinea pig liver fixed with osmium tetroxide and cut with the high-speed microtome; they observed that the 'nuclear membrane' is sharply shown, and that, generally, the fat-containing parts of the tissue appear darker in these electron photomicrographs.

But the blackening with osmium tetroxide is not a sufficient evidence for lipidic constitution of a structure. For this reason, I have undertaken a cytochemical study of the perinuclear layer in the liver cell.

Thin fragments of guinea pig liver are fixed in formalin or Regaud's bichromate-formalin mixture. The frozen sections are treated by different methods for cytochemical characterization of the lipids. With Sudan black, the thin perinuclear layer is stained blue-black, obvious not only on the edge, but also on the surface of the nucleus; so the presence of fats in this layer is shown. The reaction for cholesterol and its esters (Schultze's sulphuric acid–acetic anhydride method) is always negative; nevertheless, it is not possible to affirm the absence of these substances in the thin perinuclear layer, for the coloration is weak, and often not obvious in a very thin layer. The reaction for free cholesterol (Leulier–Revol's method using digitonin) is also negative. In addition, the Smith–Dietrich reaction is clearly positive, and indicates the presence of lipoids (phospholipids) in the perinuclear layer.

With the polarizing microscope, I failed to see in fresh liver cells any birefringence connected with the perinuclear lipoidic layer. In fact, observation is disturbed by the refraction of the cell substance.

The osmiophilic perinuclear layer of the liver cell contains some lipoids, just like those I previously studied in the perinuclear lipidic layer of the histiocyte[3]. Its thickness is irregular; measured on electron photomicrographs, the osmiophilic layer does not exceed 75 millimicrons, and it is much thinner in most segments. It is probably composed of a few sheets of radially ordered lipoidic molecules; each bimolecular film is about 5 millimicrons thick and located between protein layers.

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Staphylokinase: an Activator of Plasma Protease

Several workers[1] have reported the lysis of fibrin clots by staphylococci, and this has been assumed to be due to a fibrinolysin produced by the bacteria.

In a series of experiments, which will be reported in detail later, twenty-seven strains of staphylococci were examined for fibrinolytic activity. All strains were first tested for coagulase, using human and rabbit plasma in parallel. Fourteen out of twenty-four strains which clotted human plasma afterwards lysed the clots which they produced. Clots were produced in rabbit plasma by twenty-three of these strains; but none of these clots showed subsequent lysis. All tubes were sealed and kept at 37° C. for one week; most of the human fibrin clots were lysed in four or five days.

The twenty-seven strains of staphylococci were then grown in digest broth, centrifuged, and the supernatant fluids dialysed under toluol against tap water for two days in the cold room. Merthiolate was added to the residues after removal from the bags. Sterile residues were shown to contain both coagulase

and the fibrinolytic agent. They lysed human thrombin-fibrinogen clots in dilutions ranging as high as 1/3,000. But when either the fibrinogen or fibrin was first heated to 60° C. for half an hour to inactivate plasminogen, or when soya bean trypsin-inhibitor was added to the mixture there was no lysis.

Since soya bean trypsin-inhibitor inhibits plasmin but not bacterial proteases, it appears that the staphylococcus produces an activator of plasminogen and not a true fibrinolysin, and that its action is similar to that of streptokinase. This explains the absence of lysis with rabbit fibrin, since Christensen[2] has shown that rabbit plasma contains an inhibitor, anti-plasmin.

It is unfortunate that there has been so much confusion over terminology in this field of investigation. The plasminogen and plasmin referred to here correspond to the pro-fibrinolysin and fibrinolysin of American workers[3], and anti-plasmin to anti-fibrinolysin.

The action of staphylococci on the fibrin of other species is being investigated.

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Hæmolytic System in the Blood of Malaria-infected Monkeys

THE isolation of a hæmolytic substance from normal human blood plasma has previously been reported[1]. It has so far been characterized as an unsaturated monocarboxylic fatty acid having one double bond and the possible chain-length C18. This substance has been found to be widely distributed and has been isolated in varying amounts from a large number of animal tissues, brain especially giving a high yield.

Antimalarial drugs inhibit specifically the hæmolytic activity of this fatty acid *in vitro*[2]. This fact led to the assumption that "the malaria parasites at some stage of their development produce a metabolite closely related to the naturally occurring hæmolytic substance, and that the effect of antimalarial drugs *in vivo* is bound up with their action on this metabolite". This hypothesis is now supported by further experimental data. Heavily parasitized (*Plasmodium knowlesi*) monkey blood has been examined as to its content of hæmolytic substance and has given a manifold higher yield (25–75 ×) than normal monkey blood, varying with the degree and duration of the infection. The content of hæmolytic substance in parasitized blood is increased both inside the erythrocytes, which normally contain only little, and in the plasma. Microanalysis of the hæmolytic substance isolated in crystalline form from parasitized blood was made by Dr. G. Kenner, of the Chemical Laboratory, Cambridge, and so far has shown no difference from the hæmolytic substance obtained from normal blood and other tissues.

The malaria parasites, therefore, seem to produce or cause to appear inside the erythrocytes a hæmolytic substance, possibly identical with the physiological fatty acid, which destroys the erythrocytes when its concentration is high and is then released into the plasma. The production of a hæmolytic substance by the parasites may be thought of as enabling the metabolic utilization of the constituents of the erythrocyte by the parasite and the release of the merozoites.

This mode of erythrocyte destruction by the parasite is accentuated by another parasitic metabolite, namely, the malaria pigment, which is a hæmatin compound. Hæmatin, which is not a normal breakdown product of hæmoglobin, has itself been found to be hæmolytic *in vitro* in low concentrations down to 1/50,000. In still lower, subhæmolytic concentrations (1/200,000), it strongly potentiates the effect of the hæmolytic substance. In the light of these results, it might be interesting to study the quantitative relations of these two factors in the blood of blackwater fever cases.

I am indebted to Dr. F. Hawking, of the National Institute for Medical Research, London, for providing me with the samples of monkey blood used in these experiments. A detailed report will appear elsewhere.

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Nitrogen Metabolism After Fracture

AFTER a severe injury, such as a fracture, nitrogen balance usually becomes negative and the body loses nitrogen. The extent to which local effects of the injury (damage to tissues and disuse atrophy of muscles) contribute to this outpouring of nitrogen appears to have received little attention. The only direct measurements of loss of tissue from fractured limbs are those of Cuthbertson, McGirr and Robertson[1], who studied rats. These investigators fractured one femur of each rat, and on the tenth day after injury the animals were killed and both hind limbs were weighed. The average difference in weight between the sound limb and the injured limb was 1·03 gm. Assuming the material lost from the injured limb to have been muscle, they calculated that this difference in weight was equivalent to a loss of 32·2 mgm. nitrogen. There was, however, an average excess output of 425 mgm. nitrogen in the urine during the first nine days after fracture. From these observations it would seem that very little of the excess nitrogen excreted after fracture comes from the tissues of the injured limb.

We thought it desirable to repeat these experiments with certain modifications: first, the animals were killed five or six days after fracture, because it was thought that by the tenth day reparative processes may have partly compensated for earlier loss of tissue; secondly, direct determinations were made of the nitrogen lost from the injured limb, rather than indirectly by weighings of tissue. Two groups of rats receiving a 25 per cent casein diet were used, and the urinary collections and fracture technique were similar to those employed in previous experiments[2]. The first group of rats were killed five days after fracture, the second group six days after fracture. By this time the main phase of increased nitrogen excretion was ended in each group. The hind limbs were skinned and dissected from the trunk, using anatomical landmarks in order to achieve symmetrical removal of right and left limbs. After weighing, each limb was digested in concen-

Group of rats	No. in group	Mean body-weight (gm.)	Mean difference between right- and left-hind limbs		Mean excess output of N in urine during post-fracture period (mgm.)
			Weight (gm.)	N (mgm.)	
I	6	346	0·68 (= 21·3 mgm. N*)	60·3	205·7
II	5	166	0·16 (= 5·0 mgm. N*)	11·2	128·4

* Calculated from 1 gm. rat muscle = 31·3 mgm. N (Cuthbertson *et al.*[1]).

trated sulphuric acid, and nitrogen determinations were made on aliquots. As indicated in the accompanying table, the mean differences in weight between the injured and uninjured limbs were smaller than the mean difference found by Cuthbertson *et al.*[1]; but differences in the nitrogen content of the limbs found by actual analysis were greater than nitrogen losses calculated on the basis of differences in weight. The nitrogen lost from the injured limb did not, however, account for more than a small proportion of the extra output of nitrogen in the urine after the injury. These observations accordingly confirm the view put forward by Cuthbertson[3] that the greater part of the nitrogen lost from the body after an injury comes from sources other than the injured limb.

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Effect of Colchicine Treatment on the Alkaloidal Content of *Datura metel*

As a result of the work of Rowson[1], who found that the induced polyploids of various Solanaceous plants possessed higher alkaloidal contents than the normal varieties, we have investigated during the past two years the effect of colchicine treatment on the alkaloidal content of *Datura metel*, a commercial source of hyoscine.

A batch of seeds of *Datura metel* was well mixed and divided into two equal portions, one of which was treated with 0·4 per cent aqueous colchicine solution, as described by Rowson[1]. During March 1946 the seeds were sown in boxes and the plants reared under glass until about six inches high, when they were planted in the open on the materia medica farm at Dartford. The treated and the untreated plants were placed in separate plots but, so far as was practicable, under identical growing conditions. At the beginning of November 1946, the plants were harvested and a representative sample of each type assayed. The experiment was repeated in 1947 and the analytical results for the whole investigation are summarized below.

	1946		1947	
	Untreated	Colchicine-treated	Untreated	Colchicine-treated
Total alkaloidal content (%) expressed as hyoscyamine, calculated with respect to the plant in 60-mesh powder dried at 100° C.	0·422	0·419	0·401	0·438

These figures do not seem to us to support the view that colchicine treatment of the seeds results in a significant increase in the alkaloidal content of the plants; but in so far as we were unable to obtain any evidence of polyploidy by microscopical examination of our treated plants, it appears that in our experiments we were unsuccessful in producing polyploid species of *Datura metel*. We think that our results should be recorded, however, for the benefit of other workers interested in the practical applications of polyploidy.

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Structure of Yeast Ribonucleic Acid

During recent years, facts have accumulated about the electrometric titration of samples of yeast ribonucleic acid isolated by various methods. All the titration curves published[1–6] show on analysis the presence of a group titrating in the range *p*H 5·0–8·0; further, the pentose nucleic acid of the larvæ of *Calliphora erythrocephala* exhibits a similar dissociation[7]. The amount of this group present varies slightly with the samples used by different observers, but is generally of the order of 0·7 equiv. per statistical tetranucleotide in the polynucleotide, and it has been shown by Fletcher, Gulland and Jordan[3] that this value approaches close to 1·0 equiv. per four atoms of phosphorus on correction for the phosphorus-deficiency commonly encountered in this nucleic acid. There appears to us to be no reason to suppose that the simplest interpretation of this observation is not the correct one, namely, that the group is a secondary phosphoric acid group; this conclusion was reached by Fletcher, Gulland and Jordan[3] and by Chantrenne[4]. The suggestion put forward by Allen and Eiler[2] that this group is a very weak primary phosphoric acid group could only be accounted for on the basis of a much greater disturbance of the interrelationships of the groups in the polynucleotide than has so far been contemplated.

Any proposed structure for yeast ribonucleic acid must take into account the evidence derived from titration, which demands the presence of three primary and one secondary phosphoric acid groups, three amino-groups and two purine-pyrimidine 'hydroxyl' groups for every four (corrected) atoms of phosphorus in the polynucleotide. The simplest formulæ on this basis are those proposed by Fletcher, Gulland and Jordan[3], which are based also on the assumption that the phospho-ester linkage is the main internucleotide bond. At least one other formula which involves pyrophosphate groups and ether linkages satisfies the titration data, but is not acceptable on stereochemical, and perhaps chemical, grounds.

The experimental results of Zittle[5] on the enzymatic degradation of yeast ribonucleic acid, which are considered by him to invalidate the formulæ of Fletcher, Gulland and Jordan[3], cannot at the moment be explained, particularly in view of the facts that, on our analysis, the electrometric titration curve of his nucleic acid initially showed 0·7 equiv. of a secondary phosphoric acid group per tetranucleotide, and that enzymic degradation liberated 3·45 addi-

tional equivalents of a secondary phosphoric acid group, as stated by him. The total number of such groups is thus 4·15, the maximum possible being 4 on the basis of any structure for a polynucleotide with the correct theoretical phosphorus analysis. The sample titrated by Zittle would have had to contain about 28 per cent of its weight of water for its phosphorus content to have agreed with the theoretical value; and since this figure is much greater than that normally found, it follows that the phosphorus content was low and that the maximum possible number of secondary phosphoric acid groups must in this case have been less than 4; thus the total of 4·15 equivalents, found experimentally by titration, must have been even more divergent from that theoretically possible in this instance than is at first apparent. We do not consider that the evidence presented by Zittle is at present sufficient to override the considerable weight of experimental fact which is in favour of the formulæ of Fletcher, Gulland and Jordan.

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Adsorption of Calcium Ions by an Acid-extracted Brown Alga under Continuous Flow Conditions

The interaction of simple ions with plant cells has been frequently studied, and it has been found that in some cases cations and anions are both absorbed in the vacuoles[1], while under different conditions the readjustment of the salt content occurs mainly by ion exchange[2]. The experiments now to be described belong to the latter type; but, so far as I am aware, this is the first time that the ionic adsorption by a plant material has been systematically studied under flow conditions comparable to those prevailing in inorganic chromatographic adsorption analysis.

The measurements were done with the brown alga *Ascophyllum nodosum* and with solutions containing calcium ions. The fully swollen well-washed algal material, in which the majority of the cells appeared to be dead, was prepared from particles varying between 5 and 50 mesh/inch, and had been extracted with 1 *N* hydrochloric acid, at 20°, for about half an hour, thereby exchanging the various metals in the cell tissue against hydrogen ions[3]. The ionic adsorption is characterized by the break-through capacity, α, the number of equivalents of calcium adsorbed until the calcium can just be detected in the effluent; by the half saturation value, β, the equivalents of calcium adsorbed until the calcium concentration in the effluent is one half of that of the original solution; and by the exchange ratio, γ, the equivalents of acid in the effluent per one equivalent adsorbed calcium. The α- and β-values were not detectably influenced by illumination or by the oxygen content of the solution, but they depend on the history, age and particle size of the adsorbent and on the rate of flow, acidity and concentration of the solution. The exchange ratios, γ, were found to be near unity, which indicates that the uptake of calcium ions depends mainly on a conversion of the water-insoluble acids contained in the cell tissue into the relevant calcium salts, which are also water insoluble. The algal material used for these tests contained 2·8 gm.-equivalents of such acids per kgm. dry weight[3]. In most runs the α- and β-values were much smaller than 2·8; that is, the calcium ions appear in the effluent before the absorbent is fully neutralized. If, however, the *p*H value of the solution is relatively high, the break-through capacity approaches the neutralization equivalent, and under such conditions the adsorption capacity of this alga is similar to that of certain recognized cation-exchange materials.

A detailed account of these experiments is to be published elsewhere.

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Ferromagnetic Structure of Cold-Worked Austenitic Stainless Steels

In magnetic wire recording, the medium most frequently used for the recording of music is chromium-nickel austenitic stainless steel, which has been rendered ferromagnetic by drawing into fine wire. By suitable heat treatment after drawing, it has been found possible to obtain intrinsic coercivities ($_JH_c$) as high as 500 oersteds, a value so far in excess of the normal range for steels that some explanation seems required.

From the recording characteristics briefly described below, we have been led towards the idea of a dispersion of ferrite particles, probably long in relation to their cross-section, and of individual volumes of the order of a single domain, in a non-magnetic matrix of austenite. Support to this conception is given by the well-known results of the X-ray study of face-centred cubic structures[1] such as austenite, and the probability that the ferrite is produced along the slip planes of cold work; by the evidence both of magnetic testing and of X-ray examination that hard-drawn wires consist of some 50 per cent ferrite and the best heat-treated wires of only about 10 per cent; by the similarity between the variations of remanence with heat treatment for these wires and those for non-magnetic substances containing ferromagnetic impurities[2]; and by the close resemblance between the recording performance of these wires and that of magnetic tapes in which the medium consists of fine ferromagnetic particles embedded in a non-magnetic adhesive. A series of notes by Néel[3] have put forward an explanation of the high coercivities found in powders of cubic ferromagnetics and certain alloys on the assumption of inclusions of magnetic substances of extremely small dimensions in a non-magnetic matrix, and the recent important communication by Prof. E. C. Stoner and E. P. Wohlfarth[4], on the interpretation of high coercivities in ferromagnetics,

provides a general picture into which our conclusions, developed from quite another starting point, fit very well.

Very briefly, the development is as follows. To produce a sine wave, the changes in magnetization must occur in many small, rather than a few large, steps; the ferrite must therefore be relatively evenly distributed in the wire. The ratio of maximum (undistorted, hence wire not saturated) signal strength to minimum (undistorted, although superposed on the minute variations causing the almost inaudible background noise) is of the order of 1,000 to 1, which represents the ratio of the number of particles undergoing reversals of direction of magnetization; the total number of particles in the cross-section of the wire is probably therefore of the order of 10^6–10^9. For a wire of standard diameter (0·004 in. = 10^{-2} cm.) containing 10 per cent ferrite, the mean diameter of a single particle would therefore be between $3{\cdot}2 \times 10^{-6}$ and 10^{-5} cm., so that a number might well be less than the critical value (300 A. for iron spheres given by Néel, and of the same order by Stoner and Wohlfarth) below which single domain formation is energetically possible. Again, the length of a particle must be of the order of half the wavelength of the highest recordable frequency; at 2 ft./sec. with the high-coercivity wires, frequencies of 70 kc./s. can be recorded, and probably very much higher. Taking 100 kc./s. as the maximum, the length would be $3{\cdot}05 \times 10^{-4}$ cm., but it is quite probable that this frequency is too low and that the mean particle-length is less. These tentative values suggest particles of a cylindrical or prolate ellipsoid shape and of single-domain dimensions.

It is hoped to develop more fully elsewhere the method of approach outlined above.

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Effect of the Electron Beam on the Voltage Distribution of a High-Voltage Multi-Stage Electron Accelerator

During the course of experiments on electrostatic focusing with a multi-stage accelerating tube[1], and afterwards with a multi-stage X-ray tube, it has been observed that the electron beam acts as if it were a potential divider (not necessarily uniform) connected to the accelerating electrodes.

In the early experiments, when attempts were made to control the potentials of the accelerating electrodes by means of corona points, the voltage distribution was found to vary with the beam current. Unless the corona current was equal to, or in excess of, the beam current, the potential distribution was controlled mainly by the beam current. These results were repeated using a potential divider in place of the corona points, and the effect observed at voltages up to 300 kV. d.c. using two, three and four stages of acceleration.

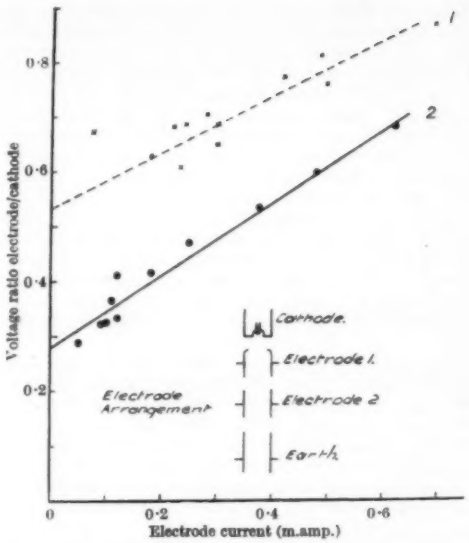

Fig. 1. Ratio of voltage on electrodes (1 and 2) to voltage on cathode as a function of current flowing to electrode – cathode current kept constant at 10 m.amp.

Later experiments were carried out on a three-stage X-ray tube fed from three high-voltage transformers in cascade, and the voltage of each stage in the cascade could be varied independently. The electrode arrangement is shown in the inset in Fig. 1; the currents were measured by milliammeters inserted in the leads to the electrodes, and the voltages by potential dividers.

Experiments were carried out varying the stage voltage ratios, and the corresponding d.c. currents to the electrodes observed. Some of the results are recorded in Fig. 1, from which it will be seen that at some particular ratio of voltages the current to the electrodes approached zero. It is of interest to note that with the particular electrode formation used, the voltage across the upper stage was greater than one third of the total voltage at zero electrode current. The manner in which the gradient varies with the electrode currents is clearly illustrated in Fig. 2, with a beam current of 10 m.amp.

From these results it was concluded that the electrodes would acquire the potential distribution indicated by the voltage ratios at zero electrode current in Figs. 1 and 2 if allowed to float and to

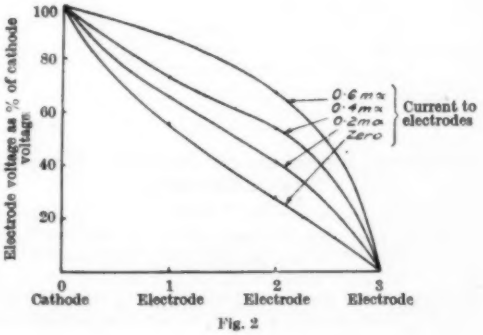

Fig. 2

depend for their source of potential solely on the beam of electrons flowing down the accelerating tube. That this conclusion was correct was confirmed afterwards by running the accelerating tube from a D.C. source and measuring the electrode voltages by means of a spark gap and later by an electrostatic voltmeter. These experiments indicate that a resistance divider will not exercise much control over the potentials of the accelerating electrodes of a multi-stage tube unless the current flowing in the divider is equal to, but preferably greater than, the beam current. The results are of particular interest in the case of electrostatic generators of low power, where a resistance divider passing only a fraction of the full beam current is used, presumably to obtain uniform voltage grading of the electrodes of the accelerating tube.

The exact mechanism by which the electron beam charges or discharges the accelerating electrodes has not been established; but it would appear that electrons from the main beam strike the electrodes and possibly release secondaries which tend to make the potential of the electrode more positive. This alters the voltage ratio of the stage, and so alters the focusing of the electron beam that fewer electrons strike the electrodes and the potential has a negative tendency. Thus it is conceivable that the electrodes will achieve a stable potential.

From this argument it would appear that the stage potentials are related to the beam focus, and the possibility arises of controlling the voltage distribution by modifying the shapes of the accelerating electrodes. Whether the shape required for satisfactory voltage distribution would also give a suitable focus is a matter for experiment. With multi-stage tubes, however, the electrode shapes are fortunately of secondary importance compared with the ratio of the voltage across the cathode to first stage to the total voltage, and so some latitude in the electrode shape from the focusing point of view is possible.

The possibility also arises of potential control by suitable choice of metals for the electrode construction, as the number of secondary electrons produced by primary bombardment varies for different materials.

It is suggested that to obtain uniform voltage distribution under all conditions in a multi-stage accelerator the electrodes should be developed on the lines suggested to give uniform voltage distribution with the electrodes floating; and a resistance divider such as is used at present should be incorporated to control the potentials at very small beam currents (that is, with a cold cathode).

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Apparent Emission of Positive Electrons from β-Emitters

SEVERAL investigators have reported finding positive particles emitted from β-emitters[1–6], in numbers very much greater than allowed by the theory of pair production either by γ-rays or β-particles. In some cases positive particles have been found to the extent of 1 per cent of the β-radiations from substances which are not γ-emitters[4,7], and in others positive particles of surprisingly high energy have been detected[7].

It has been suggested that the theory of pair production is wrong by a considerable factor; but an extensive investigation by Crane and Halpern[8] found no disagreement between theory and experiment. Again, experiments using β-ray spectrographs have failed to confirm the existence of the supposed positive particles in anything like the numbers found in the cloud chamber. Two recent experiments[10,11], one in this Laboratory, have confirmed this result and shown that less than one positron is present in 75,000 β-particles. In addition, a search has been made for the annihilation radiation which positrons might be expected to produce, and none has been found[12].

In an attempt to resolve the discrepancy between results obtained with the cloud chamber and with other methods, a number of photographs of tracks from radium E and radium (D+E) have been taken. Radium E provides a suitable case for test because its γ-radiation has insufficient quantum energy to produce electron pairs. For the first series of photographs, radium E was deposited on a nickel wire which was placed at the centre of the chamber and along its axis. No slit system was used. The chamber had a diameter of 15 in. and was filled with air at 43 cm. mercury initial pressure. A magnetic field of 600 gauss was applied. Photographs of 316 tracks were obtained, and among them were eight which, from their direction of curvature and the increase of curvature along their length, appeared to be positrons.

In other experiments, a strong source of radium (D+E) was placed in a collimated holder with a magnetically operated shutter, so that a narrow beam of particles was obtained. The source was somewhat below the centre of the chamber. With this arrangement, more than two thousand tracks were observed, but to only two of these was it possible to ascribe a positive curvature.

Finally, some photographs were taken with the first arrangement of source but without a magnetic field, in order to observe the effect of multiple scattering on the shape of the β-ray tracks. In the forty-nine tracks which were obtained, the majority were fairly straight, some had an *S*-shape, while sixteen showed a measurable curvature in the same direction similar in appearance to a curvature due to a magnetic field. The results were in general agreement with Bethe's calculations[13] on multiple scattering. Using his formula, it can be shown that β-rays of energy less than 100 keV. will give tracks in air at atmospheric pressure with an average apparent radius of curvature due to multiple scattering of the same order as the curvature due to a magnetic field of 300 gauss; the magnetic fields used in the experiments quoted above varied between 230 and 500 gauss.

In the light of the last two series of photographs and of Bethe's theory, it would appear, therefore, that the apparently positive tracks observed both in the first part of this experiment and in the work of others, cited above, can be explained in either of two ways. In some cases, they would appear to be β-rays which have travelled full circle and the tracks of which show an increase of curvature in the sense to be expected for positive particles because of the effects of multiple scattering; the great majority of the particles which have been observed would fall into this class. In other cases, they would

appear to be β-rays, sometimes of low energy, the tracks of which show the curvature of a positive particle because the multiple scattering has counterbalanced the curvature due to the magnetic field; such an effect would explain the observation of apparently positive particles with an anomalously high energy.

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Relation Between Photoconduction and Luminescence in Zinc Sulphide

A LARGE part of the studies on the afterglow or phosphorescence of solids has been made on zinc sulphide activated by copper (ZnS–Cu). Most of the theories of phosphorescence of ZnS–Cu have been based on the assumption that, when light is absorbed by the phosphor, electrons are freed from the luminescence centres and wander about the crystal. These free electrons may then be captured by traps, where they may spend appreciable time before they are freed by thermal energy, and may, then, either be retrapped, or are recaptured directly by empty luminescence centres, thus producing luminescence. The time the electron spends in the trap corresponds to the time delay of emission in phosphorescence.

We wish, however, to direct attention to experimental evidence which indicates that traps and luminescence centres co-exist in one centre, and that each excited electron is raised to a trap-level in this centre and may not be free to travel through the crystal. This evidence is based on two simple experiments. In the first experiment the phosphor is heated to empty all traps, cooled in the dark to 90° K., and then illuminated by exciting light. On warming the phosphor in the dark, electrons escape from traps and produce thermoluminescence and, as the temperature is raised steadily, the resulting thermoluminescence is produced by electrons from traps of progressively greater depth. The curve of thermoluminescence intensity plotted against temperature is the glow curve of Randall and Wilkins[1]. If the phosphor is excited by a sufficiently small amount of light energy, only a small fraction of the traps is filled and, hence, if the electrons escaping from traps wandered through the crystal, the chance of an electron being retrapped would be very great. It may be shown that, as a result, the ratio of the height of the glow curve at high temperatures to that at low temperature would be much greater for the case of partly filled traps than for completely filled traps. The significant fact is that for ZnS–Cu this ratio is only slightly different for the two glow curves (Fig. 1), there being appreciable emission at 200° K. for curve *b*

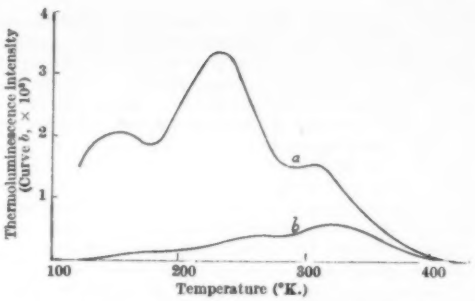

Fig. 1. THERMAL GLOW CURVES FOR A COPPER-ACTIVATED ZINC SULPHIDE PHOSPHOR (WURTZITE) FOR DIFFERENT EXCITATION CONDITIONS

(*a*) Strongly excited at 90° K.; (*b*) weak excitation at 90° K. Area under curve *a* (that is, number of filled traps) is 1,300 times area under curve *b*

in spite of the fact that only 0·1 per cent of the traps in the phosphor were filled by exciting light.

This lack of retrapping might be explained in two ways: either the traps are in the luminescence centres, or they are separate and there exists a large number of empty luminescence centres in the unexcited phosphor. The latter explanation is ruled out by the second experiment, which shows that when the phosphor with all traps empty is excited at any temperature from 350° to 90° K. by constant low illumination, the intensity of luminescence increases slowly from zero. If there were empty luminescence centres in the unexcited phosphor, the electrons liberated from luminescence centres would, to some extent, be captured directly by the empty centres, and there would be a sudden initial rise of luminescence. Moreover, when the phosphor has been exposed to previous illumination at high temperature so that some very deep traps are filled, empty luminescence centres must exist in the phosphor. When the phosphor in this condition is exposed to exciting light at room temperature, the luminescence intensity again rises slowly from zero, though more rapidly than if all the traps had been previously emptied. Therefore, it does not appear that an electron from one luminescence centre can pass

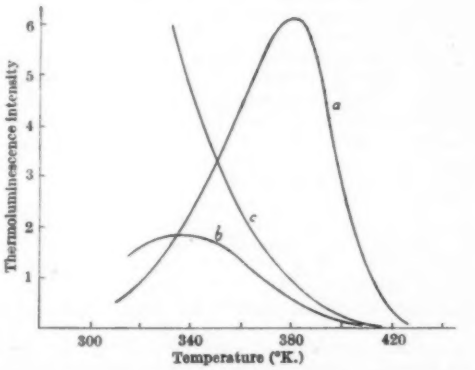

Fig. 2. THERMAL GLOW CURVES FOR A COPPER-ACTIVATED ZINC SULPHIDE PHOSPHOR (WURTZITE) FOR DIFFERENT EXCITATION CONDITIONS

(*a*) Strongly excited at 370° K. and then cooled to 295° K.; (*b*) excited by small amount of light at 295° K.; (*c*) excited by large amount of light at 295° K. (curve reduced in height)

directly to another empty luminescence centre, and one is driven to the conclusion that a large part of the luminescence of ZnS–Cu does not involve electrons travelling freely through the crystal. The photoconductivity of ZnS–Cu may be simply due to a limited displacement of the electrons within the trap and luminescence centre.

Finally, we would like to answer a possible criticism of the work of Randall and Wilkins (*loc. cit.*), who maintain that there is continuous distribution of trap-levels in such phosphors as ZnS–Cu. It has been correctly pointed out that some of the glow curves in these papers, quoted as evidence for a continuous trap distribution, could be explained on the basis of a single trap-level if retrapping is taken into account. This theory would require, however, that the shape of the glow curve should be a function only of the number of traps filled. This is not the case, however, and the glow curves in Fig. 2 show the quite different curves obtained if the traps are partly filled by strong excitation at a high temperature (the phosphor being afterwards cooled in the dark) or by feeble excitation at a low temperature. These results seem to show conclusively that the trap-levels are distributed in depth.

We hope to publish shortly further details of this work.

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Ozone and Auroral Spectra

In 1941, we published a theory[1] which provided, among other things, an explanation of seasonal and latitude variations in the thickness of atmospheric ozone. From this theory we were able to predict ozone thicknesses in latitudes for which, as yet, there are no direct observations—for example, in polar regions. Furthermore, we have shown that near the poles the ozone thickness should be practically zero soon after the winter solstice.

Now routine measurements of ozone thickness, carried out by E. Tönsberg and K. L. Olsen in Tromsö[2], have shown values so low as 0·05 cm. in December. It may be assumed that these occurrences are due to the movement of air masses from higher latitudes, so that the results afford good confirmation of our theoretical predictions.

When so little ozone is present, opportunities are offered for making spectrographic observations, as, for example, by observing the trans-auroral line 2972 A. ($^3P_1 - {}^1S_0$), O I. For this wave-length the optical density of the atmosphere is 0·60 (due to molecular scattering) and 0·365 (due to absorption by ozone), so that the intensity of radiation reaching the ground is about a tenth of that in the upper atmosphere. According to Pasternack's transition probabilities[3] and to the experimental confirmation by L. and R. Herman[4], we must expect a greater intensity for the line 2972 A. than for the line 6300 A. ($^3P_2 - {}^1D_2$), so that even allowing for a reduction of intensity of a tenth, the trans-auroral line should be observable in a zenithal aurora, in Tromsö, during a winter night when the ozone thickness does not exceed 0·05 cm.

Of course, this observation should be easier at a higher latitude, for example, in Spitsbergen, and preferably at some altitude above sea-level, in order to reduce molecular scattering. It is also to be expected that at other stations, at the same or even a lower latitude than Tromsö, the existence of polar air flows might offer still more favourable observing conditions.

It may be added that considerations of atmospheric absorption indicate that, under similar conditions, it might be possible to extend, by at least 200 A., the observed spectra of stars suitably located.

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Mass-Spectrographic Separation of Isotopes of Gaseous Elements

Experiments recently carried out in this Institute[1] have shown that, by bombarding silver disks with beams of ions of neon isotopes obtained from a high-intensity mass-spectrograph[2,3], it is possible to prepare targets, containing the separated neon isotopes, that are suitable for certain investigations in nuclear physics. Due to the high energy of 60 keV., the ions penetrate into the silver surface to a depth of about one hundred atomic diameters, and to this depth a high concentration of neon atoms can be obtained. The experimental results (*loc. cit.*) indicate that a maximum concentration is approached when the surface has been hit by about 6×10^{16} ions per cm.^{2}, corresponding to the collection of 2 μgm. of neon per cm.^{2}, if all the neon atoms remain in the surface.

In the meantime, it has been demonstrated that it is possible to release the neon atoms almost completely from the silver by heating the target material by means of high-frequency induction *in vacuo*. If a sufficiently large target area has been irradiated with neon ions, it is possible in this manner to isolate quantities of neon gas, containing one isotope only, sufficient for many experimental purposes. Experiments of this kind have also been carried out with aluminium, nickel and tungsten as target materials.

The experiments were carried out in the following way. The targets, 6·0 cm. × 2·5 cm. in size, were cleaned by means of a suitable acid, rinsed with distilled water and then strongly degassed by high-frequency induction *in vacuo*. After a target had been mounted in the mass-spectrograph, its surface was exposed, a portion at a time, to the bombardment of $^{20}Ne^+$-ions at a current of about 40 μamp., for about one hour altogether, so that maximum concentration of neon atoms in the entire surface would be ensured. Then the target was removed from the apparatus and rolled around a steel cylinder of 6 mm. diameter, in order to give it a shape appro-

priate for installation as an electrode in a Geissler tube. Each tube contained one neon-irradiated electrode and one untreated nickel electrode, and had a volume of about 30 cm.³. Moreover, each tube was provided with a small trap filled with charcoal for the absorption of small amounts of impurities which could not be entirely avoided when preparing the tubes. After the tube was evacuated, the nickel electrode and the charcoal trap were thoroughly degassed, and when the pressure had been reduced to about 10^{-5} mm. of mercury, the tube was sealed from the pump. Then the irradiated target was heated by high-frequency induction, and at a glowing red temperature the neon atoms were rapidly released from the target surface, raising the pressure in the tube to about 0·5 mm. mercury.

A spectroscopic analysis of the light emitted from the Geissler tubes showed extremely clean neon spectra. In some cases one could observe very small impurities of hydrogen and carbon monoxide which, however, could be greatly reduced by cooling the traps. In order to provide an experimental control on the amount of impurities, Geissler tubes were prepared with aluminium, nickel, silver and tungsten electrodes which had been treated in the same way as described above and installed in the mass-spectrograph, but not exposed to the beam. Immediately after heating these electrodes the tubes were capable of being ignited; but after a few minutes the impurities were absorbed in the traps and the pressure thereby reduced so that the tubes were extinguished, indicating that the pressure was less than 5×10^{-3} mm. mercury. As expected, neon lines were not observed from such tubes.

In order to determine the influence of the ionic mass on the ease of collecting a gas in a metal surface by the method described above, similar experiments were carried out with helium, argon and xenon. By bombarding a silver target with He^+ ions, a Geissler tube was prepared containing extremely pure helium gas at about the same pressure as previously found in the experiments with neon. Similar results were obtained by bombarding aluminium targets with beams of argon and xenon ions. As the experiments with xenon were carried out only to test the possibility of collecting this gas in the target surface, no separation of the xenon isotopes was carried out.

If a mass-spectrograph is to be used in this manner to prepare pure samples of the less abundant isotopes of the rare gases, more favourable experimental conditions will be obtained if substances already subjected to a partial isotopic separation by other methods are used as starting materials. Recently, a method for the separation of the isotopes ^{3}He and ^{4}He has been suggested by J. Franck[4], and preliminary experiments based on this suggestion have already been carried out[5,6]. If the application of this method proves to be successful for the separation of strongly enriched samples of ^{3}He, it may be possible to prepare pure ^{3}He gas by the mass-spectrographic method described above.

It seems likely that the mass-spectrographic method of separating isotopes of gaseous elements, which has been demonstrated in connexion with the rare gases, may be extended to other gases if suitable target materials are used. The power of metals to absorb gases to some extent, when they are hit by ions of high energy, is well known from the studies of gaseous discharges[7]; but exact measurements of the conditions under which this absorption takes place cannot be carried out by this means, as it is difficult to obtain well-defined experimental conditions. The technique described here, however, offers the possibility of a closer study of the amounts of gases that can be collected in the surface of different target materials at definite energies of the impinging ions. From theoretical arguments[8] it seems likely that the range of the ions in the target material will increase in direct proportion to the ion energy, and the amounts to be collected will presumably increase in the same proportion. It appears that the most practical way of utilizing this effect in mass-spectrographic separation experiments would be to accelerate the ions to higher energies after they have been subjected to the magnetic separation.

I wish to thank Prof. Niels Bohr for his continued interest in the present investigation. Furthermore, I should like to thank Mr. W. Drost-Hansen and Mr. S. Møller-Holst for their assistance in the work on the mass-spectrograph of this Institute.

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Normal Stress Coefficient in Solutions of Macromolecules

In a previous note[1], the most general possible stress versus strain-velocity relations for an incompressible visco-inelastic fluid have been given. They involve two physical parameters for the fluid, Θ and Ψ. Θ is the viscosity and Ψ is a new parameter which we shall term the 'normal stress coefficient'. These relations must also be valid for a visco-elastic fluid in steady-state laminar flow. From a phenomenological point of view, Θ and Ψ may be constants or they may depend on the strain-velocity invariants. If the fluid is in a steady state of laminar flow, parallel to the x-axis, the velocity gradient being parallel to the y-axis, both tangential and normal components of stress, t_{xy} and t_{zz}, exist at any point of the fluid, where

$$t_{xy} = \Theta\varkappa \text{ and } t_{zz} = -\tfrac{1}{2}\Psi\varkappa^2. \qquad (1)$$

$\varkappa$ is the velocity gradient in the fluid.

Kramers[2] has calculated the contribution of dissolved high-polymer molecules to the viscosity of a solution, using an idealized 'pearl necklace' model for the high-polymer molecule. The molecule is considered to consist of a number of equal massive points connected by equal rigid links, which are capable of some measure of rotation about the mass-points at their junctions. A number of other simplifying assumptions are made in order to make the problem mathematically tractable. The contribution $\Delta\eta$ of N dissolved high-polymer molecules per c.c., each consisting of N links of length L, is given by

$$\Delta\eta = \frac{1}{36}\,\zeta L^2 N^2 \mathcal{N}, \qquad (2)$$

where $-\zeta\mathbf{v}$ is the force on a mass-point due to the solvent, if $\mathbf{v}$ is the velocity of the mass-point relative to the solvent in its neighbourhood. It is assumed that the solution is sufficiently dilute to make the interaction between the dissolved high-polymer molecules negligible.

Employing a method similar to that of Kramers, we have shown that the contribution to the normal stress coefficient Ψ' for high-polymer molecules, in which the links are considered to be freely rotating, is given by

$$\Psi' = \frac{1}{405}\,\frac{(\zeta L^2 N^2)^2}{4kT}\,\mathcal{N}, \qquad (3)$$

where k is Boltzmann's constant and T is the absolute temperature of the solution.

If the links in the high-polymer molecules are not capable of any rotation and are collinear, then

$$\Delta\eta = \frac{1}{72}\,\zeta L^2 N^3 \mathcal{N}, \qquad (4)$$

and

$$\Psi' = \frac{1}{1080}\,\frac{(\zeta L^2 N^3)^2}{4kT}\,\mathcal{N}. \qquad (5)$$

From (2) and (3) we obtain, for the case of flexible molecules,

$$\Psi' = \frac{4}{5}\,\frac{(\Delta\eta)^2}{kT\mathcal{N}}. \qquad (6)$$

Similarly, from (4) and (5) we obtain, for the case of rigid molecules,

$$\Psi' = \frac{6}{5}\,\frac{(\Delta\eta)^2}{kT\mathcal{N}}. \qquad (7)$$

We note that, if N is large, the assumptions of flexibility and rigidity lead to very different values for $\Delta\eta$ and Ψ', but the relations (6) and (7) between $\Delta\eta$ and Ψ' differ very little.

It appears from the calculations that, in both the cases considered, the non-vanishing of Ψ' arises from the orientation of the dissolved molecules in the flow-field, which—in both Kramers' calculation and ours—is assumed for simplicity to be undisturbed by the presence of the dissolved molecules.

For a 25·7 per cent solution of polystyrene in xylene, Ferry[3] gives the viscosity as about 220 poises at a velocity gradient of 9 sec.$^{-1}$. Taking the intrinsic viscosity as 2·5, we see that if the dissolved polystyrene molecules act independently of each other, the viscosity of the 25·7 per cent solution should be about 0·37 poises. In order to explain the much higher value of viscosity actually measured, we assume that the dissolved molecules interact and that for the purposes of calculation the effectively non-interacting flow units are no longer the $\mathcal{N}$ dissolved molecules but a much smaller number $\mathcal{N}'$ of groups of many molecules. A very rough estimate of this number $\mathcal{N}'$, which has only a limited physical significance, can be obtained from the figures given above, together with the molecular weight of the polystyrene. Introducing this in place of $\mathcal{N}$ in (6) and using the measured viscosity value for $\Delta\eta$, Ψ' can be calculated.

From (1) we obtain, when $\varkappa = 9$ sec.$^{-1}$,

$$t_{xy} \approx 2 \text{ gm. wt./cm.}^2 \text{ and } t_{zz} \approx -18 \text{ gm.wt./cm.}^2. \qquad (8)$$

We see that t_{zz} is numerically greater than t_{xy}. In obtaining the formulæ (2) to (7), it is assumed that $t_{zz} \ll t_{xy}$, so that the result (8) has no quantitative significance. However, it shows that a concentrated high-polymer solution, such as that considered, should show quite appreciable values of the normal stress component, at any rate comparable with the value for the tangential stress component, even at such a low velocity gradient as 9 sec.$^{-1}$.

The above discussion is not intended to provide a precise method of calculating the normal stress coefficient, but merely to show qualitatively that a non-zero normal stress coefficient can arise from the orientation of high-polymer molecules in flowing solutions and that for concentrated solutions it may be expected to have a measurable value.

This investigation was carried out at this Institute under the sponsorship of the Reconstruction Finance Corporation, Office of the Rubber Reserve, while I was on leave from the British Rubber Producers' Research Association, Welwyn Garden City, Hertfordshire, England.

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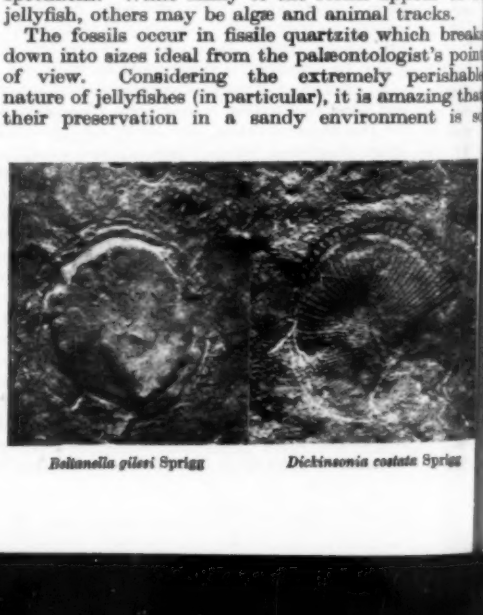
Jellyfish from the Basal Cambrian in South Australia

I WISH to bring to notice a recent find of remarkably well-preserved impressions of jellyfish, animal tracks and certain problematical forms in the basal quartzite of the Cambrian in South Australia. Originally, I found about a dozen impressions, eight of which have since been described[1], four of them possibly having jellyfish affinities. Since that time, Sir Douglas Mawson with a party of students, and still later I myself, collected one hundred or more additional specimens. While many of the forms appear to be jellyfish, others may be algæ and animal tracks.

The fossils occur in fissile quartzite which breaks down into sizes ideal from the palæontologist's point of view. Considering the extremely perishable nature of jellyfishes (in particular), it is amazing that their preservation in a sandy environment is s



Beltanella gilesi Sprigg *Dickinsonia costata* Sprigg

excellent (see photographs). Canals, (?) gonads and mouth structures are frequently clearly visible, and in one form, *Beltanella*, a velar membrane is present.

Now that a considerable amount of new material is available for description and comparison, it is hoped that a more complete study of these interesting forms will be possible. Criticisms and suggestions would be most helpful in the continuation of this study.

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[1] *Trans. Roy. Soc. South Austral.*, 71 (2) (1947).

Cementiferous Paints and their Uses

THE reference by Dr. L. A. Jordan[1] to the possibilities of cementiferous paints as fireproof coverings for the interior of warships makes it advisable to supply an earlier chapter in the history of these paints. The fact that metallic particles interact with certain chlorides to give cement-like masses was noticed by Dr. U. R. Evans, of the University of Cambridge, when working on a Service problem in 1940. He later extended the idea to produce water paints which could be applied to a wet steel surface, and which provided cathodic protection to the steel, even where exposed at discontinuities. Such a paint was put into industrial use in 1942 in a plant where rapid corrosion cracking had caused frequent stoppages in a process of high war priority, and has been in use ever since. Here, the conditions are quite exceptional, and it is unlikely that the paints have any advantage in the average terrestrial situation.

Thornhill and Mayne carried out at Cambridge detailed study of the setting and protective mechanism, working for the Iron and Steel Institute Corrosion Committee (now the British Iron and Steel Research Association Corrosion Committee). Much work was also carried out, first by the Cambridge investigators, later at Caernarvon by J. C. Hudson, and finally at Millport by K. A. Pyefinch, on the possibilities of these paints for protecting steel plates immersed in sea-water; the results have been encouraging.

The Admiralty is represented on the Corrosion Committee, and the idea that the paints might be useful in combating the menace of rapidly spreading fires (such as occurs in ships painted internally with oil paints) appealed to those working on paint in the Admiralty Chemical Department at Portsmouth. Thornhill carried out some experiments late in 1943 on cementiferous fireproof paints, and took samples to Portsmouth in 1944. These were tested by the Admiralty chemists, who reported the coats to be insufficiently resistant to abrasion. Mayne then suggested the use of an overlying silica coat produced by means of ethyl silicate. Apparently this has solved the problem. Meanwhile, the Admiralty chemists appear to have continued researches on the paints, and have evidently achieved notable advances by the addition of industrial spirit, which allows the paints to be kept in a ready-mixed condition.

It is understood that ship trials have been carried out by the Admiralty, with encouraging results, of the possibilities of these paints as underwater protection paints.

Dr. U. R. Evans is anxious to emphasize the fact that these paints are unlikely to be of value except in certain special situations. Unauthorized statements seem to have appeared in the technical Press, and these have evidently led to misunderstanding. It can only lead to disappointment to apply a paint—or anything else—in the wrong situation.

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Flint Flaking

WITH reference to the letter from Dr. T. T. Paterson under the title "Earliest Known Prehistoric Industry"[1], I wish to express my indebtedness to him for having brought his new discoveries for my examination at home, so that I could compare them with my collection of natural flakings. I have been familiar with patches of intensive flaking below the Weybourne Crag for many years[2]. On some I have counted 50 per cent of flaking among the stones—a not unusual frequency.

The evidences of localized sites may be misleading. For example, the flaking on such a site may be all of one date; but before drawing a conclusion one must inquire whether on a wider area an identical type of flaking is of miscellaneous dates. Again, an associated group of flaking is not necessarily a human working, it may be a 'Nature's workshop'; in other cases, abraded flakings have been drifted together upon the sub-Crag floor.

Neither this, nor any other disputed group, carries flaking that is superior to that from the sub-Eocene site at Grays. This occurred in the Bullhead Bed, locally modified by the addition of large flints brought in through solution of the underlying Chalk. Some flaking is general in the Bullhead Bed; but this was a localized site of special character, which, in other circumstances, could well have been mistaken for a human industry[3].

My point of view is that while it is not possible to distinguish human from natural flaking upon every separate specimen, I am convinced that mechanical movements under pressure, concussions and the like produce their respective groups of forms which are recognizable[4]. To the best of my judgment, the sub-Crag flakings conform to the distinctive characteristics of movements under pressure.

My tentative suggestion is that the whole of the effects of crushing, striation and flaking observed among the flints of the Crag sea-floor are due to the grounding of floating ice. At least, purely mechanical effects due to that, or some other cause, are conspicuous, and I submit that the problem of this remarkable flaking, with its rostro-carinates, flakes and edge-chipping, should be considered as a whole in association with the physical evidences.

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HORMONE-MIMETIC AND OTHER RESPONSES OF THE SILKWORM (*BOMBYX MORI* L.) TO SOME POLYPLOIDOGENIC AGENTS

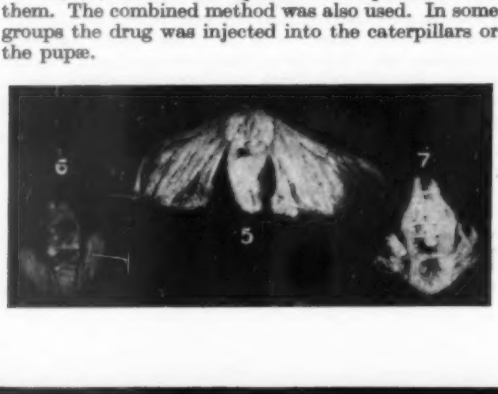
By L. J. HAVAS and J. KAHAN
Hungarian Biological Research Institute, Tihany

ACCOUNTS have been given by the senior author[1,2,3] of a series of 'hormonal' responses of plants and animals to the polyploidogenic agent colchicine. He has also repeatedly pointed out that such effects were, as often as not, independent of the polyploidizing action of the alkaloid. Other authors have come to similar conclusions[4,5,6].

Hirobe[7], using colchicine, has elicited blocked mitoses and polyploidy in the silkworm. Preliminary experiments, carried out according to the plans of the senior author by H. Tangl (unpublished), gave no indication of such effects. We decided in consequence to change the methods of administration of the drug and to repeat the treatments, following the method of Clark, Hanson and Rowntree[8], through several generations, in order to obtain, if possible, cumulative hormonal effects. The role of such effects in eliciting polyploid mutations in plants was shown by Havas[9]. The first stage of this work is described below.

The experiments were carried out partly on 'bivoltinized' and partly on freshly laid eggs or on recently hatched larvæ. In some groups the treatments were repeated after each moult up to, and including, the pupal stage. One thousand six hundred animals were treated in all. The polyploidizing agents used were colchicine, acenaphthene[10], and podophyllin, a resin isolated from *Podophyllum peltatum*. The first two are well known. Dr. I. Cornman has directed our attention to the third, his own and the experiments of other workers[11,12] having demonstrated that it is a powerful agent in inducing blocked mitoses and polyploidy in plant and animal tissues.

The eggs were treated with colchicine or podophyllin in Petri dishes, 40–60 eggs of each group being put into a 1 : 2,000 or 1 : 5,000 solution of the drugs. Water was used for the controls of the colchicine groups, and a 1 : 2,000 solution of acetone for the controls of the podophyllin-treated animals, because the resin was dissolved first in a small quantity of acetone. The methods of treatment of the larvæ with colchicine varied in the different groups. Some groups were placed in Petri dishes on filter paper wetted with solutions of the drug ranging from 1 : 10,000 to 1 : 400,000, or the caterpillars were painted with them. The combined method was also used. In some groups the drug was injected into the caterpillars or the pupæ.



The acenaphthene treatment of eggs and larvæ was also carried out in Petri dishes. 0·05 mgm. of acenaphthene was dissolved in 0·5 ml. of ether, and the solution was poured into the inverted lid, which was put in place when the ether had evaporated. The agent was left to act by sublimation for from 45 minutes up to 16 hours. Only a few examples of the results obtained will be given here, a more detailed account being in preparation.

Colchicine at a concentration of 1 : 2,000 stimulated the hatching out of the eggs but, curiously enough, inhibited it at a concentration of 1 : 5,000. In the same concentrations podophyllin had the opposite effects. The death-rate of both the 'colchicine' and 'podophyllin' animals was in direct relation to the concentrations, 1 : 2,000 being toxic. Acenaphthene either inhibited entirely the emergence of larvæ from bivoltinized eggs, or its effects were practically nil.

The accompanying table shows the effects of colchicine (1 : 100,000) and of acenaphthene (10 hours) on growth and weight of the caterpillars.

Days		Length (mm.)	Weight (gm.)
11	Colchicine	12·19 ± 1·63	0·0276 ± 0·00102
	Control	11·45 ± 1·75	0·0248 ± 0·00391
24	Colchicine	30·90 ± 4·42	0·264 ± 0·03778
	Control	28·60 ± 4·97	0·185 ± 0·03218
32	Colchicine	40·60 ± 7·86	0·880 ± 0·1705
	Control	36·20 ± 6·66	0·573 ± 0·1054
14	Acenaphthene	6·00 ± 1·00	0·0040 ± 0·00068
	Control	15·40 ± 3·16	0·0423 ± 0·00868
28	Acenaphthene	30·00 ± 8·16	0·327 ± 0·0889
	Control	38·60 ± 4·74	0·538 ± 0·0462
41	Acenaphthene	47·70 ± 7·52	0·918 ± 0·0145
	Control	62·50 ± 5·94	2·235 ± 0·2222

It was further observed that larvæ treated with colchicine at a concentration of 1 : 100,000, and still more at concentrations of 1 : 200,000 and 1 : 300,000, began to spin their cocoons earlier than did the controls and reached the chrysalis and imago stages earlier. Acenaphthene—the definite narcotic action of which was also noticed—retarded all these stages of development and metamorphosis. There seemed to be only one sphere of action in which colchicine and acenaphthene produced comparable effects, and this was the induction of morphological anomalies and colour changes. No. 7 of the photograph (kindly taken by Dr. L. Felföldy) shows one of these aberrant imagos with hypertrophied thorax and stunted and partly truncated wings, both bearing yellow maculæ, and No. 6, a stunted variation of coffee-brown colour. No. 5 represents one of the controls. Colour changes were also observed in the larval stage under the influences of colchicine and acenaphthene. Insects with vestigial antennæ or entirely lacking them were frequent in both groups. A rather curious phenomenon was encountered among the 'colchicine animals': an imago, the head, thorax and wings of which were still enclosed in the hard chitinous pupal covering, and which, in spite of this, had laid eggs.

The role of the corpora allata being well known in the above developmental and growth processes, as well as in the colour changes[13,14], the hormone-mimetic effects of the agents may be ascribed, among others, to their influence on the polarity of translocation or on the synthesis of the manifold products of this endocrine organ. However, as regards the inhibitory actions of acenaphthene, the part played by its narcotic effects and the consequent suspension of important vital processes must also be taken into account in interpreting the reactions elicited.

It is not yet known whether the morphological anomalies observed are to be considered as simple variations, as the ephemeral manifestations of hormonal or pharmaco-dynamical actions, as '*Dauer*'-modifications, or as true mutations. The manner of the 'mendelization' of their offsprings will answer these questions next season.

These investigations were partly aided by grants of the Hungarian Department of Agriculture, Bureau of Researches.

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INDUSTRIAL CO-OPERATION

THE delegates to the annual conference of the British Association for Commercial and Industrial Education, which was held at Ashridge in October 1947, were welcomed by the president of the Association, Sir Charles Tennyson, who stated that "the task confronting us to-day will require a range of knowledge in natural science, economics, sociology and psychology of which our grandfathers can never have dreamed, and a degree of perseverance, common sense and mutual consideration which must be a severe tax on human frailty. It is clear that education can make an inestimable contribution to the solution of these difficulties but . . . there seems to be a general consensus of opinion that education has made the mistake of confining itself to 'subjects', dealing with these in isolation and not relating them sufficiently to the needs and circumstances of society and man's everyday life and avocations.

"On the other hand, industry and commerce . . . have failed to realize that they have a responsibility to promote the development of individual capacity and sense of citizenship. They have also failed to realize how much academic training can do to improve the efficiency of the young employee who has been regarded simply as an economic unit to be made as immediately productive as possible at the smallest expense. That is not the way to produce skilled workmen, efficient managers, broadminded and creative technicians or good citizens."* Sir Charles then declared that the motive in calling the delegates together was the belief that unless educationists, industrialists and representatives of the workers come together to deal with this question of education and training in the spirit of research and whole-hearted co-operation Britain has little chance of overcoming its difficulties.

The initial address was given by Mr. F. C. Hooper, formerly director of business training to the Ministry of Labour and National Service, who dealt with the part which management should play in bringing about industrial co-operation. When an administration is faced with the need to change a situation, he said, its first essential task is to change the habit-patterns that have been built up under and by the old situation that is to be changed. The immediate situation we wish to change is one of poor or half-hearted co-operation between management and labour in business and to establish in its place a situation of full and enthusiastic co-operation in which management and labour are a real organic working team. This co-operation can only come if both parties recognize that they possess a single overriding common interest which wholly justifies them in establishing a common aim and which inspires them in working together to achieve it. Of the forces which stand in the way of establishing full co-operation one of the most important is the actual nature of the trade unions. Formed as fraternities to curb and combat the power of employers, to-day they have become essentially 'antibodies'. When management considers how it can most effectively attain the co-operation of its employees, it must always reckon with the fact that the rank and file of organised labour are extremely suspicious of management and that this suspicion will not be eradicated in any short term. The only way in which antibodyism and suspicion could be abolished would be by the logic of events from without and the efforts of trade union leadership directed to the same end from within. Mr. Hooper then suggested various means by which the climate of work could be made favourable to produce the maximum response by all workers in industry, and suggested that, in his opinion, schemes of education and training are of paramount importance.

Replying for the trade unions, Mr. Harold Clay, assistant general secretary of the Transport and General Workers Union, stated that over a very wide field in industry, especially among the industrial workers, there was considerable suspicion, doubt and hesitation about schemes for education and training. There undoubtedly existed in the minds of the wide body of the working population the idea that some of the 'enlightened' ventures that are now being embarked upon are merely another form of dope or opiate to keep the workers quiet at this particular time. In his opinion, education and training was part of a much wider problem, and until a real sense of social purpose had been built up which was accepted by all sections in industry, any attempt to find a solution to our present difficulties would fail. This sense of social purpose should be quite distinct from individual advantage, firm advantage or industry advantage. Relationships generally between management and workers, and those they represent, should be such that co-operation must be possible over a very wide field. "There must be opportunities for the discussion of all those issues that affect, or appear to affect the interest of the workers, and this includes quite a number of problems that have hitherto been regarded as the sole concern of management."

Other speakers went on to consider how more effective co-operation could be achieved between the planners of education and the planners in industry and commerce, as well as those aspects of education and training which had proved effective in promoting good relationships between the employee and employer. This was followed by a session in which Mr. Noel Hall, principal of the Administrative Staff College at Henley, discussed the further training of higher management and particularly the way in

* "The Short Road to Industrial Co-operation." Published by the British Association for Commercial and Industrial Education, 107 Baker Street, London, W.1. 5*s*.

which this training would be given at the Administrative Staff College.

Finally, the industrialist's point of view was put clearly and forcibly by Sir Ronald Weeks, deputy chairman of Vickers, Ltd., who defined the present obligations of both employer and employee. In his view the employer must regard himself as the trustee, be honest and fair in all his dealings, study the psychology of his employees, do everything possible to ensure good working conditions, know his own job and train his staff accordingly, pay an adequate wage for an honest day's work, endeavour to give his employees a sense of security and reasonable incentives for advancement, and finally, he must provoke a sense of loyalty and a 'sense of belonging'. The employee should observe obedience to rules and a sense of discipline, loyalty to the employer, and an honest day's work.

Sir Ronald emphasized Mr. Clay's belief that spontaneous co-operation cannot come without a sense of social purpose, and indicated that to-day the size of the pay packet on one side and the profit motive on the other are considered to be much more important than the conception of the universal and social purpose in industry. Sir Ronald then put forward various suggestions for the future improvement of industrial relations, indicating ways and means in which schemes of education and training for all grades could be introduced and implemented.

Altogether some 170 delegates attended the conference and, although they represented industries and public services having widely different problems and approached the discussion from widely different points of view, the conference was remarkable for the almost complete unanimity about the solutions that should be applied to Britain's economic crisis. Among the delegates were many representatives of firms who have been world pioneers in schemes of employee education and training and who have proved by experience that such schemes are eminently practical and beneficial. At this time of emergency their experience should not be ignored. T. H. HAWKINS

HISTORY OF SCIENCE IN EDUCATION

A JOINT meeting of the British Society for the History of Science with the Science Masters' Association, the Historical Association and the Association of Women Science Teachers was recently held at the Science Museum to discuss the subject "The Place of the History of Science in Education". The meeting was very well attended, and the chair was occupied by Dr. E. J. Holmyard, who took the opportunity of welcoming Prof. George Sarton as an honorary member of the British Society for the History of Science. The opening speakers were Dr. F. Sherwood Taylor, Mr. G. Fowles (a former chairman of the Science Masters' Association), Mr. S. M. Toyne (chairman of the Council of the Historical Association) and Miss L. E. Higson (secretary, Association of Women Science Teachers).

Dr. Sherwood Taylor said that he believed the principal aim of teaching science in the schools was to enable young people to make wise and sound decisions in their daily life. The teaching should also make clear how far, and in what regions, one may trust science. Instruction in the history of science could obviously provide a valuable means to this end. There was too much tendency at the present day to teach factual rudiments only, and he would like to see more insistence upon scientific method. Where this involved a repetition of famous historical experiments, difficulties were bound to arise, since many of them did not lend themselves to the conditions of school curricula. There seemed to be a great opportunity for historical scientific films in this connexion, but such films must be of high accuracy or they would do more harm than good.

Mr. Fowles said that, in teaching science in schools, the psychological factors were very difficult in that only about 5 per cent of the pupils could ever reach the standard represented by a university scholarship, and that the method of presentation had to be conditioned mainly by the needs of the remaining 95 per cent. So far as the historical method of teaching science was concerned, he thought there were three different aspects which he would describe as anecdotal, recapitulatory and evolutionary. Everybody was agreed that the anecdotal aspect was useful; but he doubted whether it was of value in explaining scientific method. The recapitulatory system was not altogether without defect, since pioneering work did not always provide the most direct or logical solution of the problem involved. General evolutionary consideration of scientific advance had more to recommend it, and this would be particularly valuable in teaching science to classical sixth forms. He agreed that some knowledge of the history of science was of great importance, but felt that it should form part of the general history course rather than of the science course.

Mr. Toyne described the methods he had adopted of teaching the history of science to boys on all sides in a public school. He felt that the history of science should form a part of the history course, but not at the expense of the history normally taught. He emphasized the fact that social history cannot properly be explained without a knowledge of the history of science.

Miss Higson expressed the view that instruction in the history of science would be of advantage to all pupils in schools, especially those of sixth-form age. She had been distressed to find how little mention of men of science and scientific discovery was made in the standard histories used in the schools, and gave some examples. Apparently the only man of science to attract the attention of historians was Darwin. Miss Higson also remarked that she felt that science and its history should form an integral part of the 'current events' periods in schools, and agreed with Dr. Sherwood Taylor's plea for more science films.

Dr. Sarton said that in his opinion the value of the history of science was threefold. In the first place it was essential for science itself. Secondly, it formed an excellent introduction to philosophy. Thirdly, it had inherent cultural advantages, and these he would rate the highest. He gave an account of his own two-year course on the history of science at Harvard, in which he presented his students with a general survey of the developments of science and scientific thought from the earliest times to the present day, in four sessions of thirty-five lectures each.

The discussion then became general, and the consensus of opinion was that a very strong case had been made out for the inclusion of the history of science in the course for both schools and universities, and most speakers agreed that the teaching should form part of general historical study.

THE GOVERNMENT SOCIAL SURVEY

THE Government Social Survey is a social research unit created to provide Government departments with information about the habits, opinions and conditions of the people. It was set up in 1941 in response to specific administrative needs: to obtain information, for example, about war-time shortages of consumer goods and their distribution, and about the effectiveness of the information campaign of the Ministry of Food. The Survey was from the beginning controlled by the Home Intelligence Division of the Ministry of Information; and, at the moment, it is a division of the Central Office of Information. So far no final decision has been made about how the Survey is to be fitted into the Government apparatus.

The Social Survey has made nearly 140 different studies over the last five years, each of which has been individually authorized by the Treasury on the basis of a demonstrated need on the part of a Government department. The public has been interested and willing to co-operate in this work, as is shown by the fact that half a million interviews have been made, and refusals to co-operate have been of the order of half of one per cent on an average.

The wide scope of the Survey's work and its establishment as a permanent Government research organisation have demonstrated that there is a place for the social scientist in the machinery of government, and that scientific method can be applied to the social field to help the administrator to deal with an ever-increasing range of social questions. In Great Britain there is much leeway to make up in this field. We have come a long way from Charles Booth's monumental survey of "London Life and Labour", made at the end of the nineteenth century. The early English sociologists had discussed the way in which the many activities of society were interrelated; and Profs. A. L. Bowley and John Hilton had introduced us to the value of sampling techniques. But British studies were in the main concerned with establishing facts about an under-privileged section of the population, for they dealt with poverty or problems arising out of poverty; and they were, in the main, local studies.

In the United States, on the other hand, the existence of many national minorities, the use of market research—really a special type of social survey—for business purposes in the large home market, and the great stimulus to social inquiry prompted by the New Deal had forced the development of the social science disciplines. The American Institute of Public Opinion (the Gallup Poll) is an example of the kind of organisation that was developed during this period as a result of the interest in the everyday opinions and feelings of ordinary people.

The war-time inquiries of the Social Survey were a response to immediate administrative needs. The Survey collected the data on which those responsible for the organisation of the civilian side of the War based their policies: for example, information about many aspects of the problems arising from the rationing of scarce consumer goods. Thus, soon after the beginning of clothes rationing, study was made of the special clothing needs of workers in occupations where the conditions of work caused extra wear and tear on clothes, to determine how far supplementary allowances of coupons were required. Indeed, from early in 1942 regular studies were made for the Board of Trade to discover the extent of current shortages, and which sections—by population and geographically—were most affected. Man-power policy was of critical importance. The Survey aided in securing the best possible use of the available labour-power. For example, when women were registering for war-work for the first time, studies were made of the extent to which each woman felt satisfied with the kind of interview she had had. Studies were also made of the reasons why women were reluctant to join the A.T.S. and nursing.

These war-time studies were directly utilitarian. Others, of the same kind, included the use of demobilization coupons: for the issue of a demobilization coupon allowance to members of the Forces made available an enormous number of coupons, supplementary to existing civilian coupon stocks, which were capable of completely changing the previous pattern of effective demand. On the basis of studies of coupon disbursement by newly demobilized men and women, the Social Survey was able to produce information which enabled the Board of Trade to estimate the probable effect on total demand of these supplementary coupon issues, and to change its plans accordingly. Other investigations carried out by the Survey included: a survey of the extent to which economies could be made, with the least possible inconvenience to the public, in the use of some kinds of food; credit buying, a study for the Board of Trade of the extent of instalment and hire purchase trading; getting to work, a study for the Ministry of War Transport of workers' transport difficulties; inquiries on the extent to which the technical information provided for farmers by the Ministry of Agriculture was actually being used, the impact of the 'Dig for Victory' campaign on home horticulture, and a survey of garden and allotment food production. In February 1943 an investigation was made into canteen, British Restaurant and café feeding and packed meals. This was carried out for the Ministries of Health and Food, which needed to know in detail something of the feeding habits of the people: what kinds of foods formed the diet of the normal household, how these foods were prepared, and when meals were eaten. The Ministry of Food was providing extra rations for workers in canteens and British Restaurants, but did not know how many and what types of workers made use of these facilities, or what reasons there were for not doing so.

There have also been made a number of intensive, detailed studies which have had implications outside war conditions: for example, Scottish mining communities, an inquiry made for the Department of Health for Scotland, the Clyde Valley Planning Advisory Committee, and the Central and South-east Scottish Planning Advisory Committee in the autumn of 1946, had reference to the need for building new mining communities in the expanding coalfields of Fifeshire. Answers were given to the four following vital questions: (1) To what extent are existing mining communities satisfactory? (2) What is the possibility of transferring miners from areas where coalmining is declining to areas where mining is expanding? (3) What are miners' attitudes to the future of the mining industry, as they affect their attitude to alternative employment, and the attitude of their children to entering this, or other, industries? (4) What are the main social needs of a number of entirely new mining townships to be built in Fife?

During the War there were fears of a large increase of minor illnesses. It became urgent for the Ministry of Health to have some measure of the amount of illness in Britain and of the proportion of minor ailments. Successful experiments were carried out by the Social Survey to test the possibility of regular surveys of illness. From the beginning of 1945 the Survey has shown that morbidity statistics could be systematically produced, for the first time in history, covering all illnesses of the whole population, and not merely notifiable diseases. These statistics are published by the Registrar General. They are of obvious use in the preparations for the full operation of the National Health Act. This survey of sickness permits a precise estimate of the amount of working-time lost through all illness, or through the various types of illness, and also which are the major illnesses in particular regions or groups in the population.

Other intensive studies have dealt with: domestic heating and lighting, to help the Building Research Station and committees of the Ministry of Works prepare building standards; old people's occupation and family responsibilities, in connexion with a long-term investigation to be made by the Industrial Health Research Board; and water heating, an inquiry carried out in March 1947 for the Ministry of Works. The last-named report gives the distribution of water-heating appliances in Great Britain. It examines their distribution by type of district and region, type and age of dwelling and economic group; the extent to which they are used, their relative popularity, and the complaints they give rise to. There is also information about the use of laundries, and bathing habits. Studies are now being planned of consumer expenditures. These budgetary inquiries are designed to provide detailed information about expenditure among all sections of the population. The continuous flow of data to be supplied by these studies will help to provide the basis for a long-term employment policy, and they may be of use in helping to analyse the effects of taxation.

Thus, the Social Survey is now producing social data in a very wide field, and by its work is demonstrating that social scientists can develop observational techniques which provide adequate factual material from which to draw socially valid conclusions. An essential technique developed by the Social Survey is that of population sampling. Trained field-workers interview samples of the general public, or of particular sections, with a recording schedule devised so that the results of the inquiries made can be expressed statistically. Two hundred local investigators are so distributed throughout the country that they can reach the whole population. There is a research staff of twenty, and a technical staff of sixty (dealing with machine tabulation, computation and coding). The research officers include anthropologists, psychologists, sociologists, economists and statisticians. The Survey budget for the past year amounted to £60,000.

The main conclusions from war-time experiences, as stated by Mr. Louis Moss, director of the Government Social Survey, in a paper read to the Institute of Public Administration, in April 1946, are: first, the general utility of the information obtained; second, the importance of public co-operation; third, the general feasibility of sampling as a technique capable of producing information in many different fields; fourth, the value of the personal interview as a method of collecting detailed information on factual matters, and matter of opinion; fifth, the knowledge of the kind of organisation necessary to carry out such surveys systematically on a national scale; and sixth, the value of the mixed team—not only of social scientists, but including also natural scientists. For example, the co-operation of technicians and physical scientists with the social scientists on the Survey's staff has made it possible to devise methods of work which for the first time are capable of providing a picture of the complex housing situation of Britain.

The techniques employed by the Survey are helping to lay the basis for an empirical social science. They have produced basic data suitable for the studies of the research worker in economics. They have shown the way in which changes in demand could be studied in a quantitative manner. In addition, the study of attitudes is a field for the social psychologist and the sociologist. For example, in mining, not only are the social and industrial conditions of importance, but also the attitudes of potential recruits. Similarly, in the field of behaviour there is much for the social psychologist to do. The social scientist has still a great deal to learn, and the work of the Social Survey is providing a detailed experience of methods and an accumulation of social data which will be of great help.

What of the future? The statement of the Lord President of the Council in the House of Commons, when announcing the panels of his Industrial Productivity Committee, that the social sciences had a part to play, is a recognition that adequate administrative and executive action in the complicated social and economic fields demands a scientific approach. Thus, survey techniques will surely have a part to play in studying consumer needs in austerity Britain, where limited resources are available for consumer goods production.

War-time experience demonstrated that the Social Survey reports were of value when implemented at administrative level. Therefore, in arriving at a final decision about the place of the Survey in the Government machine it would be necessary to ensure the closest contacts with those responsible for making decisions on social and economic policy.

The correct employment of the Social Survey will help to make more valid Graham Wallas' early comment that "the Government has come to be engaged not merely in preventing wrong things from being done, but in bringing it about that the right things shall be done".

MAURICE GOLDSMITH

INSECTICIDAL SMOKES

APPLYING insecticides in the form of a smoke is a long-established practice. Pyrethrum has been used in this way by the Chinese for centuries, and burning nicotine shreds in glasshouses has been a common practice in Great Britain and elsewhere for a long time. These practices were empirical and there were little or no quantitative data on their effect.

The smoke may be produced by dropping the insecticide on to a hot plate, by indirect heating in a specially designed generator, or by intimate mixing with a combustible powder which is then ignited.

During the Second World War, the use of insecticidal smokes propagated by mixing the insecticide with a pyrotechnic powder was considered for use in the campaign against the Japanese. Some work was done on the subject at the Chemical

Defence Experimental Station at Porton by E. W. Bateman and G. D. Heath (*J. Soc. Chem. Ind.*, **66**, 325; 1947). In this paper the main technical principles involved in the generation of insecticidal smokes are set out and the development of a pyrotechnic insecticidal smoke generator is described.

When this method is employed, one of the crucial problems is to obtain a suitable pyrotechnic powder. The requirements of this powder as listed by Bateman and Heath are that it should be capable of burning slowly and smoothly when mixed with at least an equal weight of insecticide; that the ignition temperature should be as low as possible, in order to avoid excessive heating before combustion occurs; that it must give rise only to products which will not react with the insecticide, and these products should so far as possible be gaseous, since the presence of a hot residue assists the decomposition of the vapour of the insecticide which is forced to pass through it; it must not be unduly sensitive to friction or to heat and should not be hygroscopic, since it must be capable of being handled with safety and of withstanding storage for long periods under tropical conditions. Experiments are described using potassium chlorate and sucrose as the pyrotechnic mixture, and D.D.T. or benzene hexachloride as the insecticide. With these two insecticides there is the complication that hydrochloric acid may be liberated on storage, and a stabilizer should be added. Magnesium oxide was added for this purpose.

Since the War considerable interest has been taken in the use of this method for the control of the pests occurring in glasshouses, warehouses, farm buildings, etc., and they are now being marketed commercially. The generators consist essentially of a thin-walled metal cylinder containing the insecticide mixed with the pyrotechnic powder, an igniter composition and a fuse. The fuse is ignited, and this in turn ignites the starting mixture which sets off the pyrotechnic mixture. The smoke issues through a cooling baffle on top of the cylinder. The baffle prevents ignition of the cloud.

Smoke generators with D.D.T. and azobenzene as lethal agents are being sold by the Murphy Chemical Co., Ltd., and Plant Protection, Ltd., are selling azobenzene smoke generators and 'Agrocide' smoke generators. The 'Agrocide' generator contains the gamma isomer of benzene hexachloride as lethal agent. The smokes containing azobenzene are intended primarily for the control of glasshouse red spider mite, and the D.D.T. and 'Gammexane' smokes for the control of a number of insect pests.

The Murphy Chemical Co. at a recent demonstration held at Ryder's Nurseries showed how easy it is to fill a glasshouse with insecticidal smoke by this method. The advantages claimed for this procedure are that it is cheap and quick to apply, and labour costs are reduced to a minimum; that it gives a far more uniform distribution of the insecticide than spray application, coating both sides of the foliage and penetrating to every part of the glasshouse. The generators are self-contained, needing no apparatus for distribution. They are simple and clean to use and storage space is considerably reduced. It seems quite possible that the method may form a useful and certainly convenient addition to the existing techniques for the application of insecticides; but more information, both physico-chemical and biological, is required before its value can be accurately assessed.

In addition to the practice of gaseous fumigation and spraying in an aqueous medium, the use of aerosols produced from solutions of the toxic chemicals in propellant gases liquified under pressure, and of concentrated solutions of insecticides atomized by means of compressed air, are now being studied, and smoke generation must stand comparison with all these methods.

At first sight it would seem that smoke generators will give a better distribution and penetration than any method short of fumigation, but will have less residual effect than the aerosols, compressed air atomization and spraying. It also seems likely that the method can be used in situations where successful fumigation would not be possible.

It would therefore appear that insecticide smoke generators are most likely to be used where good distribution and penetration are required and where residual effects are of secondary importance, in situations where successful fumigation would be difficult. Although at present they are marketed for indoor use, it appears that in certain circumstances they may be useful outdoors. One limiting factor in the use of this method is likely to be the amount of destruction of the active chemical occurring during the production of the smoke.

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

Monday, April 12

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5.30 p.m.—"Aerial Mountaineering" (Technicolour Film with Commentary by Colonel Walter A. Wood).

Tuesday, April 13

ZOOLOGICAL SOCIETY OF LONDON (at the Zoological Gardens, Regent's Park, London, N.W.8), at 5 p.m.—Scientific Papers.

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "Future Trends in the Design of Receiving Aerials" (to be opened by Mr. E. M. Lee).

SHEFFIELD METALLURGICAL ASSOCIATION (joint meeting with the SHEFFIELD SOCIETY OF ENGINEERS AND METALLURGISTS, at the Royal Victoria Hotel, Sheffield), at 6.15 p.m.—Dr. Ulick R. Evans: "Thin Films on Metals".

MANCHESTER GEOGRAPHICAL SOCIETY (in the Geographical Hall, St. Mary's Parsonage, Manchester), at 6.30 p.m.—Brigadier R. A. Bagnold: "Desert Sand Dunes".

WOMEN'S ENGINEERING SOCIETY (at 35 Grosvenor Place, London, S.W.1), at 7 p.m.—Miss L. Chitty: "Structural Engineering".

SOCIETY OF INSTRUMENT TECHNOLOGY, NORTH-WEST SECTION (at the College of Technology, Manchester), at 7.15 p.m.—Mr. H. Schmitt: "Automatic Control Applications in the Chemical Industry".

ROYAL ANTHROPOLOGICAL INSTITUTE (at University College, Gower Street, London, W.C.1), at 8 p.m.—Prof. Percival R. Kirby: "The Trumpets of Tut-Ankh-Amen and their Successors".

Tuesday, April 13—Thursday, April 15

INSTITUTE OF PHYSICS, STRESS ANALYSIS GROUP (in the English Theatre, The University, Edmund Street, Birmingham).—Conference on "Stress Analysis".

Wednesday, April 14

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 2.30 p.m.—Mr. Henry S. Horsman: "District Heating".

ROYAL METEOROLOGICAL SOCIETY (at 49 Cromwell Road, London, S.W.7), at 5 p.m.—Major H. C. Gunton: "Phenological Report".

INSTITUTE OF PETROLEUM (at Manson House, 26 Portland Place, London, W.1), at 5.30 p.m.—Mr. S. T. Minchin: "An Account of some Solid State Properties of Petroleum Waxes in Terms of their Composition".

INSTITUTION OF ELECTRICAL ENGINEERS, TRANSMISSION SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Dr. W. Wanger: "Technical and Economic Aspects of the Transmission of Electrical Energy over Long Distances".

BRITISH INSTITUTION OF RADIO ENGINEERS, NORTH-EASTERN SECTION (at Neville Hall, Westgate Road, Newcastle-upon-Tyne), at 6 p.m.—Prof. M. G. Say: "The Pulse Signal".

BRITISH INSTITUTION OF RADIO ENGINEERS, MERSEYSIDE SECTION (in the Lecture Room, Liverpool Engineering Society, 9 The Temple, 24 Dale Street, Liverpool), at 6.45 p.m.—Mr. M. P. Johnson: "Some Aspects of Moderate Precision Temperature Control in Communication Engineering".

TELEVISION SOCIETY (at the Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, London, W.C.2), at 7 p.m.—Mr. K. C. Macleod: "Radio Frequency E.H.T. Supplies".

Wednesday, April 14—Friday, April 16

ELECTRICAL ASSOCIATION FOR WOMEN (at Southport).—Twenty-third Annual Conference.

Thursday, April 15

CHADWICK PUBLIC LECTURE (in the Architectural Theatre, University College, Gower Street, London, W.C.1), at 2.30 p.m.—Mr. Thomas Ritchie: "The Sanitation of Buildings" (Bossom Gift Lecture)*.

INSTITUTION OF MINING AND METALLURGY (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Dr. Frank Dixey: Talk; Dr. W. B. Pollard: "The Detection, Separation and Microtitration of Iridium"; Mr. P. H. Kitto: "A New Form of Thermal Precipitator".

INSTITUTION OF ELECTRICAL ENGINEERS, INSTALLATIONS SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Dr. J. N. Aldington and Mr. A. J. Meadowcroft: "The Flash Tube and its Applications".

ILLUMINATING ENGINEERING SOCIETY, MANCHESTER CENTRE (in the Reynolds Hall, College of Technology, Manchester), at 6 p.m.—Mr. H. C. Ruff: "New Lamps—New Uses, and New Lighting Techniques".

ROYAL AERONAUTICAL SOCIETY (at the Institution of Civil Engineers, Great George Street, London, S.W.1), at 6 p.m.—Mr. W. E. W. Petter: "The Aerodynamic Problems of High Altitude Design".

ROYAL PHOTOGRAPHIC SOCIETY, SCIENTIFIC AND TECHNICAL GROUP (at 16 Prince's Gate, London, S.W.7), at 7 p.m.—Mr. H. S. Tasker: "Speed and Contrast in X-Ray Work".

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at Manson House, 26 Portland Place, London, W.1), at 7.30 p.m.—Dr. R. E. Rewell: "Diseases of Tropical Origin as seen in Captive Wild Animals".

PHARMACEUTICAL SOCIETY, MANCHESTER, SALFORD AND DISTRICT BRANCH (in the Council Chamber, Houldsworth Hall, Manchester), at 7.45 p.m.—Annual General Meeting.

BRITISH INSTITUTE OF RADIOLOGY (at 32 Welbeck Street, London, W.1), at 8 p.m.—Sir Ernest Rock Carling: Mackenzie Davidson Memorial Lecture.

Thursday, April 15—Saturday, April 17

ROYAL INSTITUTE OF CHEMISTRY (at Birmingham).—Annual General Meeting.

Thursday, April 15

At 3 p.m. (at the Central Technical College).—Exhibition, "The Chemist in the Midlands", to be opened by Mr. Roche Lynche; at 6 p.m. (at the University, Edmund Street).—Prof. R. P. Linstead, F.R.S.: "The Chemical Research Laboratory, Teddington".

Friday, April 16

At 11 a.m. (at the Botanical Gardens, Edgbaston).—Prof. Maurice Stacey: "The New Fluorocarbon Chemistry".

Saturday, April 17

Visits to the University and the Barber Institute of Fine Arts, Chance Bros. glassworks at Smethwick, and Marston, Thompson and Evershed's brewery at Burton-on-Trent.

Friday, April 16

INSTITUTION OF CHEMICAL ENGINEERS (at the Connaught Rooms, Great Queen Street, London, W.C.2), at 11.45 a.m.—Twenty-sixth Annual Corporate Meeting; at 2.30 p.m.—Mr. H. W. Cremer: "The Chemical Engineer and Civilisation" (Presidential Address).

INSTITUTION OF ELECTRICAL ENGINEERS, MEASUREMENTS SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. R. W. Wild: "The Electrical Measurement of Pressure and Strain, with particular reference to the Testing of Circuit-Breakers".

INSTITUTE OF NAVIGATION (at the Royal Geographical Society, Kensington Gore, London, S.W.7), at 5.50 p.m.—Commander W. E. May: "The Future of the Magnetic Compass".

BRITISH INSTITUTE OF RADIOLOGY (at 32 Welbeck Street, London, W.1), at 8 p.m.—Prof. W. T. Astbury, F.R.S.: Silvanus Thompson Memorial Lecture.

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 9 p.m.—Dr. E. V. Evans: "The Gas Industry".

INSTITUTE OF WELDING, NORTH LONDON BRANCH (at Manson House, 26 Portland Place, London, W.1).—Annual General Meeting.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

PHYSICAL CHEMIST or PHYSICIST IN THE PHYSICS DEPARTMENT—The Secretary, Royal Cancer Hospital (Free), Fulham Road, London, S.W.3 (April 15).

LECTURER (Grade II or Grade III) IN PHYSICS, and an ASSISTANT LECTURER (Grade III) IN PHYSICS—The Secretary and Registrar, The University, Bristol 8 (April 20).

ASSISTANT LECTURER IN CHEMISTRY—The Secretary, The University, Edmund Street, Birmingham 3 (April 24).

RESEARCH ASSISTANT (Grade II) IN THE SCIENCE MUSEUM LIBRARY—The Director and Secretary, Science Museum, South Kensington, London, S.W.7 (April 30).

HEADSHIPS OF THE DEPARTMENTS OF BOTANY, ZOOLOGY, CHEMISTRY, PHYSICS, at the University College of the Gold Coast—The Secretary, Inter-University Council for Higher Education in the Colonies, 8 Park Street, London, W.1 (May 1).

ASSISTANT LECTURER (Grade III) IN THE DEPARTMENT OF GEOLOGY—The Registrar, The University, Liverpool (May 1).

LECTURER IN ZOOLOGY (with special qualifications in Genetics or Marine Zoology)—The Secretary, The University, Aberdeen (May 1).

APPLIED MATHEMATICIAN IN THE DEPARTMENT OF ELECTRICAL ENGINEERING—The Secretary, Imperial College of Science and Technology, South Kensington, London, S.W.7 (May 1).

PROFESSOR OF CHEMISTRY—The Secretary and Registrar, University College of North Wales, Bangor (May 1).

SENIOR CYCLOTRON ENGINEER—The Director, Radiotherapeutic Research Unit, Hammersmith Hospital, Ducane Road, London, W.12 (May 10).

ASSISTANT LECTURER AND DEMONSTRATOR IN THE BIOLOGY DEPARTMENT, an ASSISTANT LECTURER AND DEMONSTRATOR IN THE CHEMISTRY DEPARTMENT, an ASSISTANT LECTURER AND DEMONSTRATOR IN THE PHYSICS DEPARTMENT, a LECTURER (with qualifications in Dietetics) and ASSISTANT LECTURERS AND DEMONSTRATORS IN THE PHYSIOLOGY DEPARTMENT—The Secretary, King's College of Household and Social Science, Campden Hill Road, London, W.8 (May 10).

LECTURER (man or woman) IN BIOCHEMISTRY—The Secretary, Bedford College for Women, Regent's Park, London, N.W.1 (May 14).

LECTURER IN METEOROLOGY—The Secretary of Faculties, University Registry, Oxford (June 1).

PLANT PATHOLOGIST in the East African Groundnuts Scheme—The Personnel Department, Overseas Food Corporation, Unilever House, Blackfriars, London, E.C.4.

CHEMIST (with Honours Degree) for research work on problems of Chemical Microbiology—The Secretary, Wright-Fleming Institute of Microbiology, St. Mary's Hospital, Paddington, London, W.2.

FORESTRY EXPERT for the Directorate-General of Agriculture, to act as a Deputy to the Head of the Iraqi Forestry Department—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1, quoting M.N.18183 (3C).

LECTURER IN THE DEPARTMENT OF CHEMISTRY—The Principal, Borough Polytechnic, Borough Road, London, S.E.1.

ORGANIC CHEMIST for research work on problems connected with the bleaching, dyeing and finishing of flax yarns and fabrics—The Director, Linen Industry Research Association, Linen Research Institute, Lambeg, Lisburn, Co. Antrim.

LECTURERS IN (*a*) CHEMISTRY to B.Sc. standard, and (*b*) PHYSICS to B.Sc. special degree standard—The Clerk, Northern Polytechnic, Holloway, London, N.7.

LECTURER IN BIOLOGY—The Clerk to the Governors, Battersea Polytechnic, Battersea, London, S.W.11.

BIOCHEMIST (non-medical)—The Secretary-Superintendent, County Hospital, Lincoln.

ASSISTANT EXPERIMENTAL OFFICERS (2, Chemists, male) IN THE PLANT AND ANIMAL PRODUCTS DEPARTMENT, for laboratory work in connexion with investigations of Empire raw materials of plant and animal origin—The Establishment Officer, Imperial Institute, London, S.W.7.

METALLURGIST—The Secretary, British Non-Ferrous Metals Research Association, 81–91 Euston Street, London, N.W.1.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Other Countries

International Office for the Protection of Nature. Report for the Years 1940–1946 and Review of Bibliography on the International Protection of Nature, No. 1. Pp. 40. (Amsterdam: International Office for the Protection of Nature, 1947.) [56

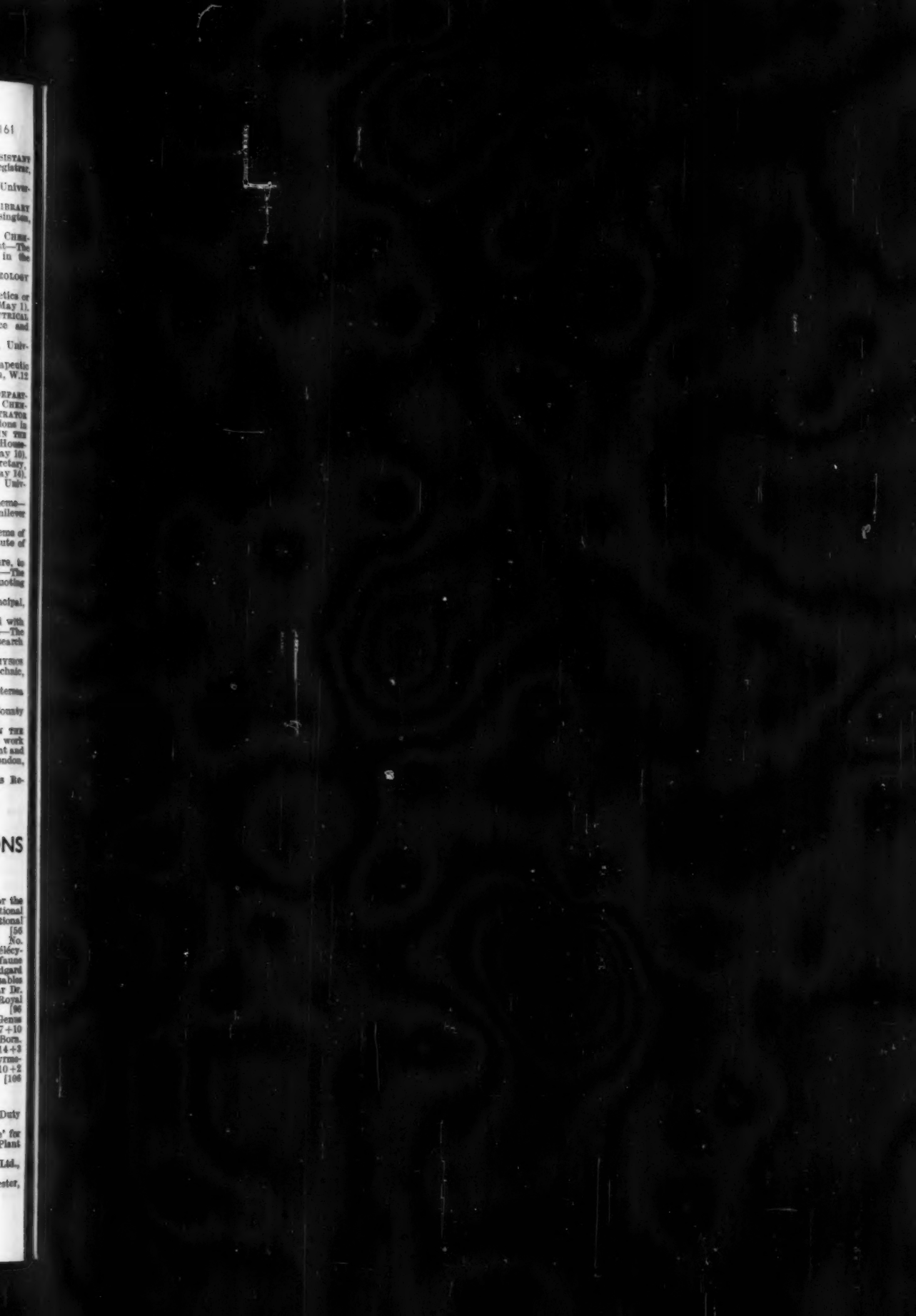
Memoires du Musée Royal d'Histoire Naturelle de Belgique. No. 103: Faune malacologique du miocène de la Belgique. 1: Pélécypodes. Par Maxime Glibert. Pp. 266+12 plates. No. 104: La faune ichthyologique du l'yprésien de la Belgique. Par Dr. Edgard Casier. Pp. 267+6 plates. No. 105: Végétaux de l'assise des sables d'Aix-la-Chapelle récoltés en Belgique (Sénonien inférieur). Par Dr. François Stockmans. Pp. 51+4 plates. (Bruxelles: Musée Royal d'Histoire Naturelle, 1945–1946.) [96

Polska Akademia Umiejetnosci. Nr. 1: The Species of the Genus *Arrhopalites* occurring in European Caves. By Jan Stach. Pp. 47+10 plates. 100 zł. Nr. 2: The Species of the Genus *Isotomurus* Born. (Collembola) occurring in European Caves. By Jan Stach. Pp. 14+3 plates. 33 zł. Nr. 3: *Lepidoatelura montana* n.g., n.sp., the Myrmecophilous Lepismid from the Balkan. By Jan Stach. Pp. 10+2 plates. n.p. (Kraków: Polska Akademia, 1945–1946.) [100

Catalogues

Hiduminium Technical Data. Pp. 62. (Slough: High Duty Alloys, Ltd., 1947.)

The 'Agrocide' Range of Insecticides based on 'Gammexane' for Agricultural and Horticultural Crops. Pp. 32. (London: Plant Protection, Ltd., 1947.)

Diodone B.D.H. Pp. 2. (London: British Drug Houses, Ltd., 1947.)

Information on High Vacuum Distillation. Pp. 16. (Rochester, N.Y.: Distillation Products, Inc., 1947.)